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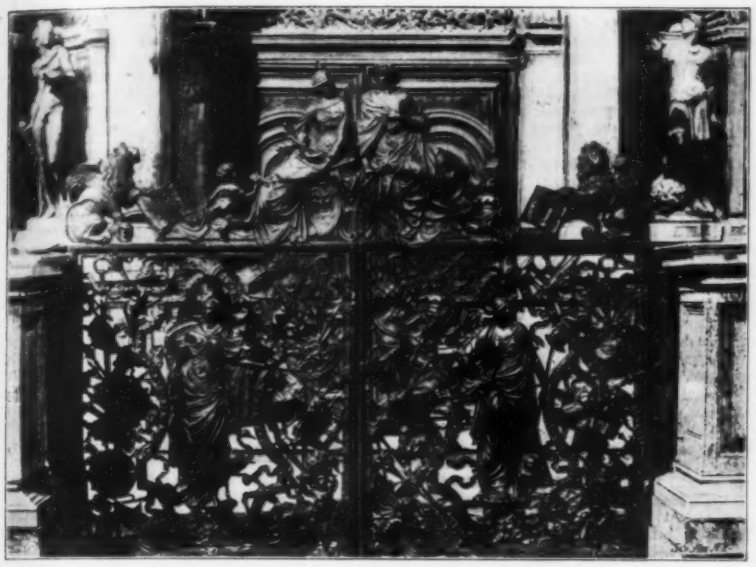
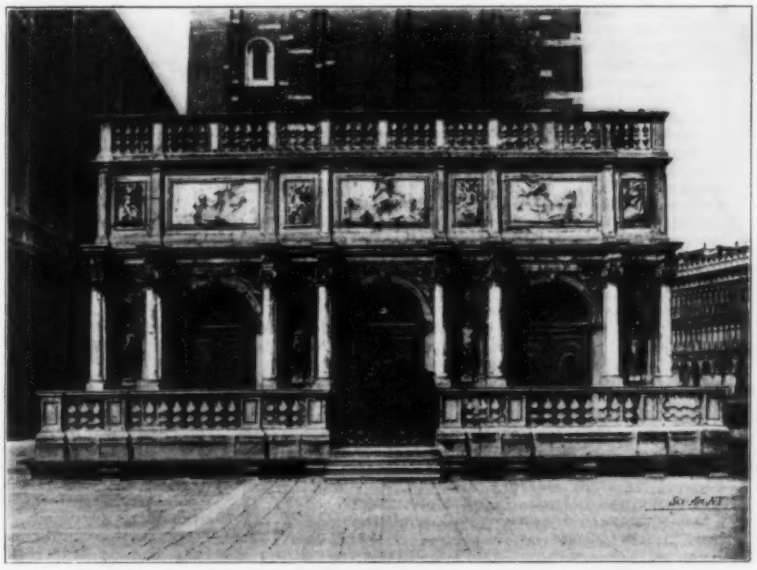


GATEWAY OF THE SANSOVINO LOGGETTA.



THE SANSOVINO LOGGETTA AT THE FOOT OF THE TOWER.

VENICE AND ITS CAMPANILE.

THE FALL OF THE HISTORIC CAMPANILE OF VENICE.

THE FALL OF THE HISTORIC CAMPANILE OF VENICE.

ONE of the most serious artistic disasters that impoverished Italy has ever sustained is the fall of the famous bell-tower of St. Mark's, Venice. Without its Campanile, Venice is very much as London would be without its St. Paul's, or New York without its Brooklyn Bridge. For centuries the Campanile formed part of the famous old Italian city's architecture—its most beautiful and its most noteworthy structure.

On Sunday, July 13, a rift appeared in the stonework of the tower. This premonitory sign allowed a partial clearance of the Piazza, and consequently there were no fatalities. The authorities had prohibited access to the tower, and had given orders to begin repairs as soon as possible. But on the morning of July 14 the grand old tower collapsed and fell into the Square. The excitable Venetians immediately clamored for a rigid investigation. Their demands are certainly justified; for only eight months ago the tower was officially declared in no danger.

The Cathedral and the Palace of the Doges are quite safe; but the Sansovino Loggetta and the library of the royal palace were carried away. Four of Sansovino's statues of Venetian nobles were demolished in the Loggetta; and a Paul Veronese painting was destroyed in the palace. The winged angel on the top of the bell-tower was hurled down to the front door of the Cathedral, smashing the Bando column, which was thrown thirty-five feet, and barely missing the column supporting the south angle of the Cathedral. Thus was a most serious accident avoided.

Historically, the Campanile was of rare interest. Begun as far back as 888 by Pietro Tribuno, it did not assume the form which European tourists are familiar with until 1590. For centuries its majestic height dominated the city. Its pinnacle was about 325 feet from the ground.

In 1417 a marble top was put on the old tower. One hundred years later it was crowned with the figure of an angel nearly sixteen feet in height. Simple in design, the Campanile stood out in sharp contrast with the famous belfry of Florence.

The Loggetta at the foot of the Campanile was built by the famous Jacopo Sansovino, and was the rendezvous for the nobles of the town. Sansovino adorned it with reliefs and with bronze statues of Minerva, Apollo, Mercury, and Peace. The bronze doors of the vestibule have long been regarded as masterpieces that deserve to rank by the side of the work of the great Italian sculptors. Like many another Italian structure, the Loggetta lost much of its old-time significance. From a meeting-place for the nobles it degenerated into a waiting-room for the commanders of the guards during the sessions of the Great Council. Latterly it was used for auctions and lottery drawings.

The tower was peculiar in that it had no staircase. It was ascended by a winding inclined plane, having thirty-eight bends and ending in a few steps. The tower was always open; but visitors were not allowed to enter alone. For that reason a single traveler was compelled to engage a bystander to accompany him.

From time immemorial a watchman was stationed in the lantern. In olden days, the days of the grand maritime Venetian Republic, it was from the tower that the watchman caught the first glimpse of homecoming war vessels. In modern times the watchman no longer scanned the horizon for vessels, but kept a lookout upon the city for fires.

The Campanile served other purposes as well. It was also used for the purpose which its name signifies. According to some authorities, four bells were hung in the olden days in the tower, to be sounded for different purposes. *La marangola* was sounded at dawn to call the laboring classes; *la sestamezzana* opened the official bureaus; *la trotterar* called the councils to duty; and the bell *del malefizio* tolled out the requiem for those who were to be put to death. A fifth bell was later brought from Candia, and tolled only on Ascension Day. In 1518 there hung halfway up the tower a wooden cage, in which prisoners were kept until they starved to death. Scientifically, the tower is of interest by reason of the fact that from it Galileo made many observations.

MECHANICAL STANDARDIZATION IN GREAT BRITAIN.

CONSUL MARSHAL HALSTEAD, of Birmingham, under date of June 10, 1902, calls attention to the following editorial from the London Times of June 9, showing the progress being made in standardization in England:

The favorable reception given by Mr. Balfour to the deputation which lately waited upon him on the subject of engineering standards, as reported by us a day or two ago, and his announcement that both the War Office and the Admiralty were prepared heartily to co-operate with the efforts of the eminent committee which approached him on the subject, are full of promise for some of those departments of British industry which of late years have been most seriously threatened by foreign competition. Few people have any adequate conception of the waste of money, of time, and of material which is consequent upon the employment of all manner of irregular shapes and sizes in various kinds of constructive work; and the evils hence arising—although attention was first called to them by an eminent Englishman more than sixty years ago—have been tolerated in this country with an indifference or supineness which has not been displayed elsewhere. It was in 1841 that the late Sir Joseph Whitworth pointed out the inconvenience constantly arising from the different patterns of screws then employed by different makers of machinery, with the result that a machine in some distant part of the world might be crippled for want of a single screw, and might remain so until sufficient time had been given to send to the workshop of the original maker for the supply of the deficiency. He proposed that manufacturers should agree upon a uniform size and pitch of thread for every diameter of screw or of aperture, and was promptly met by the contention that the form used in every workshop was, in some point or other, better than the rest. Firm A would not use the screws used by firm B, and firm C would have nothing to do with those of either. But the shrewd and patient north countryman was not easily discouraged. He evaded the difficulty by producing the exact mean of the several patterns used by the most eminent firms, and his proposal was adopted by acclamation. He had so far foreseen this result as to have quietly prepared machinery for dealing with it, and when the standard screws were accepted he was at once in a position to supply the tools necessary for cutting them. His attention was soon after diverted to other subjects, but he constantly regretted his inability to deal with other things as he had dealt with screws, and was never weary of expatiating upon the advantages which would accrue to British industry from the national adoption of a sufficient variety of standard sizes in all departments of manufacture. His favorite object lesson was furnished by a candle wabbling loosely in a candlestick, and only rendered firm by a band of paper, or by one requiring to be scraped before it could be fixed; and he would ask why candle makers should not agree as to the number of sizes required by consumers, and why every No. 1 British candle should not fit easily and correctly into every No. 1 British candlestick. The iron and timber parts of buildings, such as girders, doors, door frames, window sashes, and the like, moved him to wrath by their diversity; and he was accustomed to maintain that the convenience which would be afforded to purchasers by the general adoption of a proper number of English standards, and by accurate working to them, would be sufficient to give something like a monopoly of the trade in every branch of manufacture in which the principle was carried into effect.

Perhaps the first important step toward action upon Whitworth's principles was taken some years ago by an association representing the principal railroads of America, which had for one of its objects the attainment of uniformity in the patterns of rails and in the parts of locomotives. This association set itself to determine, for example, haw many patterns of locomotives were required for the various demands of traffic—for express engines, goods engines, shunting engines, and so forth—and how these might be made in the most economical and practical way. The result was, certain patterns having been adopted by all the companies included in the association, that manufacturers were able to work for stock at times when they had no orders in hand, and to do this without danger of finding themselves burdened with unsalable goods. An incidental consequence was, of course, comparative cheapness of manufacture, and that in a degree which speedily made itself felt when railways outside America were coming into the market as purchasers, and were content to deny themselves the luxury of engines which had been "specially designed" by their own officials. Mr. Balfour told the deputation not only that "the advantages of standardization were obvious," but also "that no human being could have a doubt as to the magnitude and the importance of the subject," and that, as far as he could offer an opinion, he entirely agreed with the views placed before him by the members of the deputation. These are strong expressions, and the majority of people will think them entirely justified by facts; but it is nevertheless true that these same views have been urged by a few persons for a great number of years, and that so far they do not appear to have met with a degree of acceptance at all commensurate either with their truth or with their importance. The case has too often been like that of the diversity of screws, but with no Whitworth to suggest the happy mean by which individual claims or pretensions could be reconciled. Every designer has been wishful to have "his own" pattern of some appliance in general, or perhaps universal, demand—a pattern a little thicker or a little thinner than that usually employed, and perhaps only representing a maximum of cost in combination with a minimum of advantage.

A variety of circumstances, however, have lately combined to force the question of standardization upon British engineers and mechanicians, foremost among them being the recent discussion as to the supply of locomotives to Indian railways and the enormous demand which has lately arisen for various kinds of electrical machinery. The merit of perceiving and of acting upon the favorable opportunity is largely attributable to Sir John Wolfe-Barry, whose plea for reform has been taken up by the Institution of Civil Engineers, with the co-operation of the Institution of Mechanical Engineers, the Institution of Naval Architects, and the Iron and Steel Institute, and has led to the formation of a very strong committee, comprising many of the most eminent names among the leading members of these bodies, with a recent addition of representatives from the Institution of Electrical Engineers. It follows that the movement is now being backed by all the leading technical societies of the country, and is being controlled by practical men who are in touch with the requirements of the engineering professions and trades. It may therefore be reasonably expected to be marked by a sufficient flexibility of adaptation to altered circumstances, so that the opposite errors of too great readiness to discard the old and of too great reluctance to adopt the new may both be effectually guarded against. It would be quite possible, of course, to erect an undue worship of standardization into a barrier against improvement, or against the adoption of modifications which the real needs of actual or potential customers might require; but any such danger appears to be much diminished by the lines on which the committee and its subcommittees have been constituted. It is a matter for great congratulation that the principal manufacturing or purchasing departments of the government should be brought into touch with the movement, so that these departments when placing their contracts may recognize the standards laid down by the committees. There is much reason to believe that the War Office and the Admiralty have in past times done a good deal to hinder the progress of manufacture by an obstinate adherence to methods or to demands which might with advantage have been suffered to become obsolete, and which would have been greatly modified in dealing with any private consumer. The more completely the spending departments can be brought into touch with ordinary requirements the better it will be alike for the manufacturer and for the taxpayer; and the more hearty the co-operation of the government with the movement which has elicited from Mr. Balfour expressions of cordial approval the more rapidly will the pessimists among us be relieved of the anxiety concerning foreign competition which they have lately had some ground both for feeling and for expressing. The British Empire has conducted a great war to a triumphant issue, and its sons must now gird themselves for equal efforts in the competitions of peace.

THE MANUFACTURE OF INDIA RUBBER.*

IT is always interesting, if not, indeed, of the first importance to take stock of the present position of a trade or manufacture in reference to what is to be found written on the subject in text-books, for the matter to be found in these volumes, unless new editions are constantly being issued, is apt to fall into the category of history, often, indeed, of archaic history, with the efflux of time. Not that this applies especially to the rubber trade; quite the reverse, for, as a matter of fact, very few fundamental changes, either in procedure or in machinery, have to be recorded since quite the early days of the manufacture. But, still, changes of a minor character are continually taking place, and it seems of interest to say a word or two about some of these selected at haphazard. Of course no attempt is here being made to treat these developments in anything like detail; the exigencies of space will hardly allow in some cases of more than the indication of their existence, but efforts will be made to include anything really essential to the topics treated of.

But to get to our subject without further introductory remarks, a commencement may be made with vulcanization, a term which, though not by its derivation entirely appropriate, yet serves its purpose as well as any other, and has come to full recognition by the compilers of English and foreign dictionaries. With regard to the use of sulphur in the operation, no other material has come forward to usurp its pride of place, and what we have to say regarding vulcanization has reference merely to altered procedure. Without going into detail, it may be said that the usual temperatures at which vulcanized rubber has been, and is still, very largely produced, range from 265 deg. to 290 deg. F., the most common being 275 deg. F., the time of exposure to this heat being on the average one hour. Lately, however, attempts have been made to considerably shorten the time with a corresponding rise of temperature; though, perhaps, the word "corresponding" is not exactly applicable in this connection. At any rate, the temperature has been raised to 350 deg. F., and the period of vulcanization reduced to 5 minutes only. This is a startling change indeed, and there are not wanting those who express their distrust at it in no uncertan voice, mainly because of the injurious action which such elevated temperatures exert upon rubber. To the best of our knowledge, the only firm who have adopted the process on the large scale are the Dunlop Rubber Company, of Birmingham, who use it in connection with some special machinery for tire-making. This machinery is of American origin, though the Doughty patents under which it is protected are now the sole property of the Dunlop Company, so far as this country is concerned at all events. It is not our purpose to attempt to criticise the process, as others have done, from theoretical considerations, especially as it may be taken for granted that the preliminary trials made at Birmingham must have proved satisfactory before the directors would have committed themselves to the erection of machinery on a large scale. All the same, we shall await the time tests of the goods turned out before finally dispossessing ourselves of the certain amount of distrust which the process has aroused in us. We believe it to be a fact that only very thin material can be treated, because of the great tendency to inequality of vulcanization in the case of thicker rubber, the exterior being extremely liable to burn, while the interior portion remains unvulcanized. This contingency does not, of course, come into serious consideration in the case of bicycle tires, though we imagine that it will be found to assume large proportions should an attempt be made to utilize the process in connection with motor tires. It may be asked, to what end is the new process if its application is not only hedged with limitations, but, in the opinion of some, at any rate, is attended with grave risks? Well, the answer to this is, rapidity of production, the new process permitting of a considerably larger daily output of tires than is possible under ordinary conditions. It is possible that an improved product is also obtained; but if this claim is put forward, we have heard nothing of it, so need not dwell upon it. And here we may leave the topic, trusting that what has been said by way of making known a new departure will not be read as in any way casting a reflection upon either its ingenuity or its fitness to properly effect the requisite degree of vulcanization.

To leave now this special topic and to glance at the present position of rubber machinery generally, the principal fact which impresses itself upon the observer is that really very little alteration is to be noted. Development has, indeed, proceeded along the lines of increased size or of improved efficiency, but there is a conspicuous absence of novelty in ideas or design. The washing or mixing rollers of the past have certainly been replaced, but only by those of a similar type and of increased size and power. The spreading machines so largely used in the manufacture of "mackintosh" garments still retain the form and dimensions familiar to the pioneers of the industry, though in this connection a few words ought to be said with regard to some improved machines which have been brought out with the explicit object of reducing the cost of

* Engineering.

labor. Into the structure and peculiarities, however, of the Frankenstein and List, and of the Rowley and Walmsley spreading machines, it would seem somewhat out of place here to penetrate, as it will be putting no slight upon the intelligence of our readers to presume that by far the greater number would be unable to follow us into the intricacies of terms and application which such a treatment to be of any value would involve. We shall rest content, therefore, with the bare statement that by the multiplication of prime-moving parts it has been sought to show, and, indeed, it has been shown, that one man can do a much larger quantity of work than with the old type of machine. And yet this attempted Americanizing procedure cannot be stated to have been a success from the patentee's point of view, judged from the sordid, but important, point of pounds, shillings and pence. Certainly one or two of the new machines are in operation, but it has been found a difficult task to overcome the manufacturers' reluctance to launch out into the capital expenditure necessary, even though it has been diligently pointed out that the extra cost of the new over the old type of machine will soon be recouped by the saving of labor. Then, again, there is the ever-present fear that incipient faults in manufacture will not be so easily detected where there are a less number of eyes to roam over the work in progress. A further fact that we understand has militated, or may well be expected to do so, against the improved machine is the attitude of the Rubber Workers' Trade Union, an attitude which has been described as bordering on extreme hostility. This, however, brings us to the whole question of labor and its relation to labor-saving appliances, into which it is not our present purpose to enter, though, of course, it would not be easy to over-estimate its importance.

So far the matter has not become at all acute; though as economy, wherever possible, is the order of the day, there can be no doubt that the manufacturers will not hang back when they see their way clearly to reduce expenses. Especially is this to be noticed in the replacement of old types of steam boilers by modern high-pressure ones, and in some few cases of the adoption of electricity as a motive power, this innovation having, we are credibly informed, been found economical and efficient. And now further economies are foreshadowed in the way of utilizing gas engines fed by Mond gas. Indeed, such economies have been declared by a prominent rubber manufacturer to be becoming imperative if our trade is to hold its own and advance in face of the foreign competition which has now become an established fact in Great Britain, and the possibilities, or rather the potentialities, of which it would be folly to make light of in a country where import duties are non-existent. There can be no doubt that those rubber manufacturers who are, or expect shortly to be, in a position to use Mond gas as a motive power will have an advantage over those less fortunately situated, if the figures which have been given to us are to be relied on.

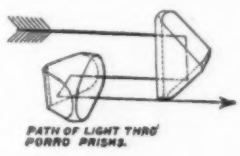
To revert, however, more particularly to machinery, mention ought, perhaps, to be made of the three-roll mixing and grinding machines made after Wicks' patent; up to this time machines with but two rolls having been in use. We understand the Wicks machine has been adopted by one of our foremost firms; and it may be taken, then, that it bears out what the patentee claims for it in the way of economy in labor. It is claimed that the addition of the third roller reduces the time of mixing a rubber compound by one-half, thus enabling the extra cost to be saved during the first year. Further, there is the point that for the double capacity only the same mill-space is occupied as in the two-roll machine. With regard to vulcanizing presses, although there is nothing particularly novel to record, yet an undoubted advance in efficiency has been attained in machines now being supplied by one or two of our rubber machinery firms. In such machines a pressure of 2000 pounds on the square inch is obtained by hydraulic power, not, however, by means of a pump, as in the old style, but by an intensifier. The presses worked on this system are said to give decided working advantages over those at one time universally and still commonly in use. The water, it may be said, enters the intensifier at a pressure of 80 pounds, and is raised, as mentioned above, to 2000 pounds. With regard to the laying out of rubber mills, it has to be noted that many of our large concerns have evolved from somewhat small beginnings, additions having been made to the premises from time to time as their desirability or necessity became apparent. Thus it has come about that a lack of unity, so to speak, is perceptible in the relation of the departments to one another, and time and trouble have to be expended in moving goods in an incomplete state of manufacture to departments where they have to undergo their next treatment. In cases where five or six-story cotton mills are now being utilized as rubber works, the movements of material and goods from one room to another by means of the somewhat circumscribed area of a lift causes a really serious loss of time and an added expenditure of labor. Of course a good deal depends on the situation of the mill; ground space cannot be utilized to the same degree in extensions in towns as it can in the country. There can, however, be no doubt that certain works situated in country districts, and whose policy has been to build as largely as possible on the one-story plan, have an advantage in the movement of goods, which is by no means an unimportant factor in the profitable conduct of the business. This plan, however, could not possibly be followed by works situated in cramped areas of towns.

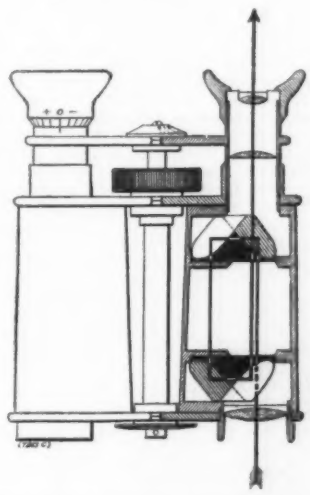
Although, perhaps, under our strict title it is hardly appropriate to discuss what are mainly financial or commercial interests, as opposed to development in procedure, yet one or two of such issues seem to call for passing notice, in order to minister to completeness. A few years ago the great rise in the price of Para rubber brought in its train serious consequences in the way of reduced profits, and this, coupled with increasing foreign competition, forced the manufacturers to take somewhat serious stock of the situation. It was recognized that, without some concerted action, attempts on the part of individual firms to raise prices must inevitably prove disastrous to the prime movers, and thus it was that an attempt was made to effect a great rubber combine on the lines of those promoted and brought into being in the textile trades. Complications, however, soon developed in the early stages of the attempts to consolidate the rather divergent rubber interests, and the absolute refusal of one or two of the largest concerns to merge their individuality led to the project being abandoned. The movement, however, led to the formation of the India-Rubber Manufacturers' Association, membership of which is limited to actual proprietors of works; and this association, it may be said, has in many ways and in an unobtrusive manner done much for the interests of its members in certain directions where acute competition had reduced profits to an almost irreducible minimum. Moreover, without its existence the general rise of prices in manufactured goods, so as to bring them into conformity with the rise in price of the raw material, could not have been effected, or, at any rate, could not have had the desired result. One of the outcomes of the high price of Para rubber was a more general recognition of the advantages of the African product. Another result—and one, it must be confessed, of not quite so commendable a nature—was to bring into increased use what is known as recovered or reclaimed rubber, a product of varying composition, and in many cases of dubious qualifications as a substitute for new rubber. It has, however, many legitimate uses in low-quality goods, and has undoubtedly come to stay. A large amount has of late years come to us from America as a product of old goloshes; but it is somewhat interesting to note that a large works, financed by Americans, has recently been erected in the neighborhood of Liverpool to engage in its manufacture. Of course there are Englishmen engaged in the business, but the invasion of American capital and American methods is quite a new departure, and one which cannot fail to have an important influence both upon the position of our own producers and upon American exporters.

These notes have now attained to a length beyond which it would, perhaps, be difficult to sustain the reader's attention, and they will now be brought to a conclusion with the remark that the selection of the topics has been conducted in a haphazard way, with no attempt at orderly sequence, such as would naturally have been expected in a set treatise, or even in a survey professing to deal in anything like an exhaustive manner with recent developments in a trade so complex as is that which is concerned with the manufacture and sale of india rubber.

THE PORRO PRISM FIELD-GLASS.

"THE How and the Why of the Porro Prism Field-Glass" is the title of a paper by Mr. W. R. Warner. The title sounds a little like a problem in psychology,





THE PORRO PRISM FIELD-GLASS.

but it is, on the contrary, the views of a man who knew what he was talking about and described matters as they were. In general, the field-glass described is the combination of an ordinary objective with an astronomical eye-piece in a binocular field-glass. The Porro prisms are a combination, as shown above, where two prisms, each having one 90 deg. angle and two 45 deg. angles, are shown in their relative positions. A pencil of light, or the image of an object passing through them, is inverted. In respect to the prisms the author says:

The prisms serve a two-fold purpose, the first and most important being, as has been said, the erection of the object observed; and the second, the shortening of the telescope by twice turning the ray of light upon itself, so that the total length adjusted for use, whether for 6, 8, or 10 power, is but 4 inches, and the total weight, in binocular form, but 13 ounces; so small and light, indeed, that it can easily be carried in the pocket. Each triple barrel of the prism field-glass contains two double reflecting prisms, as shown in the diagram above. The rays of light passing through the object-glass enter the first prism in such a way as to be twice totally reflected, each time at an angle of 90 degrees, thus emerging parallel to the entering ray, but in the opposite direction. It is then caught by the second prism, and is similarly reflected and sent on its course toward the eye-piece, in its original direction, without change, except in one very important particular, viz., the image of the object observed, which without the intervention of the prisms would be upside down, is now erect, and is ready to be magnified by the simple astronomical eye-piece, just as the stars and planets are magnified in the largest telescopes.

In regard to the perfect focal adjustment, he says:

The depth of focus, so called, is always in direct ratio of the focal length of the object-glass to its aperture. This ratio in the best Porro prism field-glasses is not less than 6, while in the best opera-glasses, or in the old type of field-glasses, it varies from 2 to 3. These latter are therefore at least twice as sensitive to focal adjustment as are the Porro prism field-glasses, which beyond 100 feet are practically of universal focus.

As to why the object was so clearly and sharply defined, Mr. Warner says:

The prisms allow nearly all the light that enters the object-glass to pass to the eyes, only about 10 per cent being lost by passing through the lenses and prisms. The light efficiency is accordingly about 90 per cent, a proportion more than double that possible in either of the old forms of field-glasses.

Finally, how can the field be so surprisingly large here, or why is the field shown by the old-time glasses so small? Let us try and get a correct comparison of the two types of telescope.

When observing with the Galilean telescope (opera-glass type), the rays of light are divergent as they enter the eye, and the field of view can be moved over an extended area by moving the eye about the eye-lens of the instrument, just as when looking through a conical roll of paper from the larger end. The size of the field must always be small, as in the case of the paper cone, and is limited by the diameter of the object-glass, precisely as the hole in the small end of the paper cone limits the field of view shown when looking into the larger end.

The Porro prism field-glass is constructed on exactly the opposite principle. The rays of light are convergent as they enter the eye, as in looking through the paper cone from the small end, giving a large and uninterrupted field, three times the diameter (nine times the area) that is possible in the old instrument of the same power, the field of view being governed by the astronomical eye-piece instead of by the size of the object-glass.

In the development of the prism binocular it has been found that the magnifying powers which may be most advantageously used range from 6 to 10 diameters. It is true that no one power is best for all purposes. A good average, however, is reached in the 6 and the 8 powers, which are those in most popular use. The uninitiated often make the mistake of thinking that the highest powers are most desirable, which is far from the fact. Any increase in power must be met by a decrease in field of view, by a diminution of light, and also by an increase in the effect of unsteadiness of the instrument while observing. The Porro prism glasses are so short that they can be better held than any other kind of terrestrial telescope, and therefore there is no practical difficulty in holding an 8-power with sufficient steadiness to make terrestrial observation successful. Any higher power than this is apt to cause annoyance from the reasons mentioned, while the 6-power (which is as high as any of the old-style Galilean field-glasses) is eminently satisfactory for natural history and general landscape observations; and the fact that its field is three times as large as is possible in the Galilean telescope of the same power is enormously in its favor.

The author gives two reasons why this invention had been impracticable for so many years. The best optical glass at the time of the invention absorbed so much light as to forbid the use of Porro prisms; and it is only recently opticians have known how to make absolutely flat surfaces, so as not to distort the object seen through a Porro prism.—Engineering.

VIRTUES OF THE PINEAPPLE.

THE partaking of a slice of pineapple after a meal is quite in accordance with physiological indications, since, though it may not be generally known, fresh pineapple juice contains a remarkably active digestive principle similar to pepsin. This principle has been termed "bromelin" and so powerful is its action upon proteids that it will digest as much as one thousand times its weight within a few hours. Its digestive activity varies in accordance with the kind of proteid to which it is subjected. Fibrin disappears entirely after a time. With the coagulated albumen of eggs the digestive process is slow, while with the albumen of meat its action seems first to produce a pulpy gelatinous mass, which, however, completely dissolves after a short time. When a slice of fresh pineapple is placed upon a raw beefsteak the surface of the steak becomes gradually gelatinous owing to the digestive action of the enzyme of the juice.

Of course it is well known that digestive agents exist also in other fruits, but when it is considered that an average sized pineapple will yield nearly two pints of juice, it will be seen that the digestive action of the whole fruit must be enormous. The activity of this peculiar digestive agent is destroyed in the cooked pineapple, but unless the pineapple is preserved by heat there is no reason why the tinned fruit should not retain the digestive power. The active digestive principle may be obtained from the juice by dissolving a large quantity of common salt in it when a precipitate is obtained possessing the remarkable digestive powers just described.

Unlike pepsin, the digestive principle of the pineapple will operate in an acid, neutral, or even alkaline medium, according to the kind of proteid to which it is presented. It may, therefore, be assumed that the pineapple enzyme would not only aid the work of digestion in the stomach, but would continue that action in the intestinal tract. Pineapple, it may be added, contains much indigestible matter of the nature of woody fiber, but it is quite possible that the decidedly digestive properties of the juice compensate for this fact.—The Lancet.

MORTARS.

THE guns denominated mortars were in special honor in the time of Vauban. It was, in fact, to "ricochet" firing that that great capturer of strongholds owed his memorable successes. Placing them in judiciously selected places, he pierced the faces of the works of the besieged and soon put their artillery material out of service. Such a result obtained, it only remained to make a breach and begin an assault, an operation which was an affair of but short duration. Mortars continued to be employed with no less success during the siege of Sebastopol. The Russians made use of them in large numbers, and rained upon

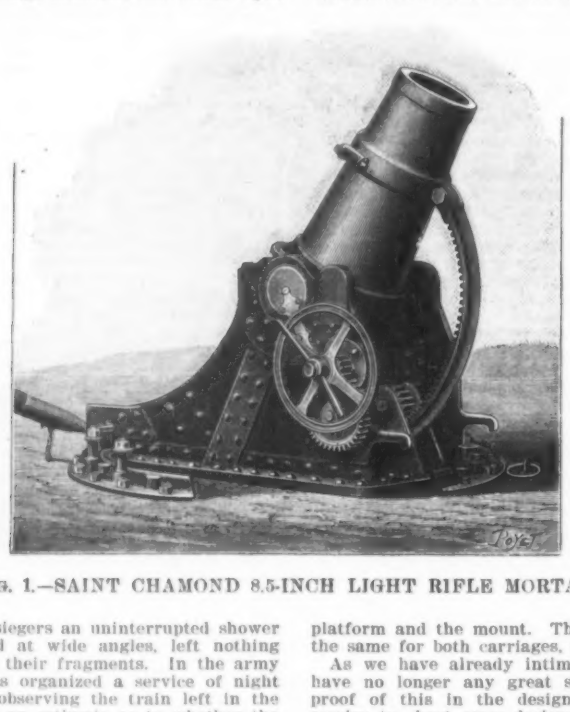


FIG. 1.—SAINT CHAMOND 8.5-INCH LIGHT RIFLE MORTAR.

the trenches of the besiegers an uninterrupted shower of bombs, which, fired at wide angles, left nothing under protection from their fragments. In the army of the allies there was organized a service of night observers, who, upon observing the train left in the sky by the fuse, made an estimate as to whether the bomb was to fall in their direction, and, when such was to be the case, gave the well-known cry: "Look out for the bomb!" Thereupon everyone squatted close to the parapet of the trench or lay flat upon the ground in order to escape the effects of the explosion. These big spherical projectiles have had their day; but, as for the mortars that fired them with so great noise, they still exist in name, yet how greatly transformed! Their chamber has been elongated and rifled; they are loaded at the breech just like other guns; and they are even arranged upon carriages with recoil cylinders. It is a far cry from these new weapons to the old smooth-bore mortars drawn upon rudimentary carriages.

Properly speaking, it may be said that there are now no longer any mortars. The pieces that we continue to style thus are merely short howitzers—howitzers themselves being simply short cannon. All ordnance is now of practically the same construction, the only differences between the various pieces residing in the caliber and length, the former of which permits of varying the weight of the projectile and the latter of increasing or diminishing its velocity.

Smooth-bore mortars disappeared and gave place to rifled ones after the war of 1870. Breech-loading was not immediately adopted for the latter, which were at first loaded at the muzzle. The closing of the chamber by the projectile was assured by what was called an expansion ring, which expanded under the effect of the pressure of the powder gas.

The Saint Chamond Works was one of the first to construct breech-loading rifled mortars. The one which we represent (Fig. 1) was experimented with at Bourges by the War Department fifteen years ago.

This piece, which had a bore of 8.66 inches, was without recoil and fired shells 43.3 inches in length containing 66 pounds of explosive powder.

At the Exposition of 1900 there was exhibited a weapon presented by the Skoda establishment of Pilsen, Austria, and called a 9.36-inch siege and fortress gun (Fig. 2). This piece, which may be considered as typical of modern mortars, weighs 4700 pounds. It is mounted upon a cradle and consequently has a total weight of 7578 pounds. The platform, with the body of the mount, weighs 7779 pounds. The hydraulic recoil cylinder permits of a recoil of 12 inches. The shell weighs 297 pounds. The charge is 5 pounds of smokeless powder, which gives the projectile an initial velocity of 984 feet.

This material is transported by two carriages, the fore-carriages of which weigh 1210 pounds. The first carries the mortar and its cradle, and the second the platform and the mount. The weight to be hauled is the same for both carriages, say, about 10,230 pounds.

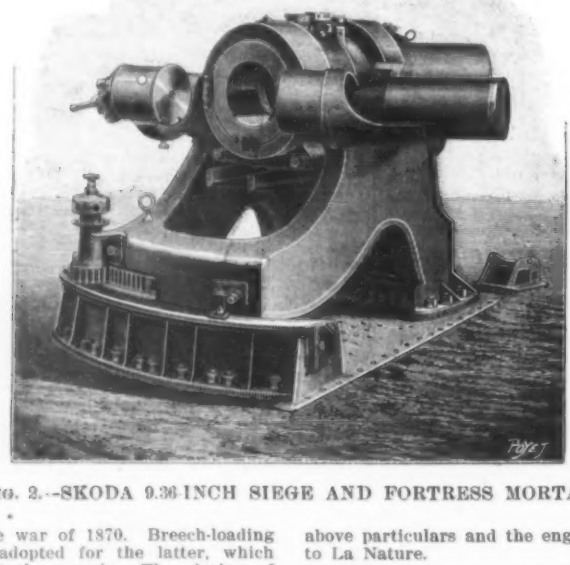


FIG. 2.—SKODA 9.36-INCH SIEGE AND FORTRESS MORTAR.

As we have already intimated the names of guns have no longer any great significance. We have a proof of this in the designation given in different armies to short guns designed for campaign service. In Germany these are called "howitzers;" in France, "short guns," and in Russia, "mortars." In fact, the last Exposition showed us a Russian campaign mortar of the Engelhart system—a very ingeniously constructed piece in which the recoil was limited by the action of rubber buffers.

Upon the whole we may report that there are no longer any mortars. The name may still exist in Austria and Russia, but, in reality, none of the pieces that continue to be designated thus has the least affinity to the weapons that permitted Vauban to attain such wonderful results. There is no reason for being surprised at such disappearance when we take into account the wonderful progress that has been made in modern armament. As compared with the present guns the old mortars, even those with which the maritime coasts were studded, are nothing but weapons of too ordinary power. Bombs were certainly respectable projectiles by reason of their weight; but the slowness with which they were fired, the feeble velocity with which they were impelled, and their slight precision gave them nothing more than a ridiculous efficiency. It was but natural that they, along with mortars, should disappear.—For the above particulars and the engravings we are indebted to La Nature.

Silver Polishing Soap.—Stir 10 kilos of caustic soda lye of 28 deg. Bé. into 10 kilos of cocoanut oil at 30 deg. C. and heat the whole at a temperature of not exceeding 50 deg. C. until the saponification is completed. Now mix 30 kilos of powdered tripoli intimately with the above and pour the soap into iron molds or wooden boxes lined with zinc. This soap may be colored with fat-soluble aniline dye previously stirred with a little cocoanut oil.—Il Profumiere e Saponiere Italiano.

THE PROGRESS OF ELECTRIC SPACE TELEGRAPHY.*

By G. MARCONI.

WIRELESS telegraphy, or telegraphy through space without connecting wires, is a subject which at present is probably attracting more world-wide attention than any other practical development of modern electrical engineering. That it should be possible to actuate an instrument from a distance of hundreds or thousands of miles and oblige it at will to reproduce audible or visible signals through the effects of electrical oscillations transmitted to it without the aid of any continuous artificial conductor, strikes the minds of most people as being an achievement both wonderful and mysterious. If we examine the subject closely we may, however, come to the conclusion that, although telegraphy through space is certainly wonderful, as are likewise all natural and physical phenomena, yet it is certainly in no way more wonderful than the transmission of telegrams along an ordinary telegraph wire. The light and heat waves of the sun and stars travel to us through millions of miles of space, and sound also reaches our ears without requiring any artificial conductor. It is not, therefore, wonderful that man should have devised means by which he is enabled to confine electricity conveying messages or power to a wire and cause the effect which we call an electric current to follow all the turns and convolutions which may exist in the wire?

We find that the first systems of telegraphy used by mankind were truly wireless. A bonfire built on a hill by a band of aboriginal Indians conveyed a signal wirelessly by etheric waves—in this case light waves—to Indians on another hill, perhaps miles distant. Even to-day there are innumerable systems of what may truly be called wireless telegraphy in practical use. A red light at a railway crossing conveys a signal by waves through the ether to the eye of the engine driver. The red light is the transmitter, the eye the receiver.

The method of space telegraphy of which I intend speaking to-night is founded on a comparatively new way of controlling and detecting certain kinds of etheric waves, much slower in rate of vibration than light waves, called Hertzian waves, after the scientist who first demonstrated their existence. The mathematical and experimental proof by Clerk Maxwell and Heinrich Hertz of the identity of light and electricity, and the knowledge of how to produce and detect certain previously unknown ether waves, made possible this new method of communication. I think I am right in saying that the importance of the discoveries of Maxwell and Hertz was realized by very few, and even, perhaps, so recently as a year ago a great number of scientific men would have hardly foreseen the advances which have been made in so brief a time in the art of space telegraphy.

The time allowed for this discourse does not permit me to describe all the various steps which have made possible the results recently obtained nor to describe the work of the numerous workers who have contributed to the advance of the subject, but I hope it may be of interest if I describe the various problems which have lately been solved, and the very interesting developments which have taken place in my own work during the last few months. I shall first briefly describe my system as used in my early experiments six years ago, and afterward endeavor to explain the various improvements and modifications which have since been introduced into it.

The transmitter consists of a modified form of Hertzian oscillator, the main feature of which is in having one sphere of the spark discharger earthed and the other connected to an elevated capacity area or to a comparatively vertical wire. The two spheres are also connected to the ends of the secondary winding of an induction coil or transformer. When the key is pressed the current of the battery is allowed to actuate the spark coil, which charges the spheres and the vertical wire, which, when discharging, causes a rapid succession of sparks to pass across the spark-gap. The sudden release caused by the spark discharge of the electrical strain or displacement created along certain lines of electric force through space by the charged wire causes some of the electrical energy to be thrown off in the form of a displacement wave in the ether, and, as a consequence, the vertical wire becomes a radiator of electric waves. In this connection it is interesting to remember that Lord Kelvin showed mathematically more than 40 years ago the precise conditions under which such a discharge as we are considering would be oscillatory. It is easy to understand how, by pressing the key for longer or shorter intervals, it is possible to emit a long or short succession of impulses or waves which, when they influence a suitable receiver, reproduce on it a long or short effect, according to their duration, in this way reproducing the Morse or other signals transmitted from the sending station.

The receiver consists of a coherer (on the nature of which I hope to make a few further remarks later) placed in a circuit containing a local cell and a sensitive telegraph relay actuating another circuit, which works a trembler or decoherer and a recording instrument. In its normal condition the resistance of the coherer is infinite, or at least very great, and the current of the battery cannot pass through it to actuate the instruments, but when influenced by electric waves the coherer becomes a comparatively good conductor, its resistance falling to between 100 and 500 ohms. This allows the current from the local cell to actuate the relay, which in turn causes another stronger current to work the recording instrument and also the tapper or decoherer, which is so arranged as to tap or shake the coherer, and in this way restore its sensitiveness. The practical result is that the circuit of the recording instrument is closed for a time equal to that during which the key is pressed at the transmitting station, and in this way it is possible to obtain a graphic, acoustic or optical reproduction of the movements of the key at the sending station. One end of the tube, or coherer, is connected to earth and the other to an insulated conductor, preferably

* Lecture delivered at the Royal Institution, June 13.

terminating in a capacity area similar in every respect to the one employed at the transmitting station.

I noticed that by employing similar vertical rods at both stations, it was possible to detect the effects of electric waves, and in that way convey the intelligible alphabetical signals over distances far greater than had previously been believed possible, and by means of similar arrangements distances of transmission up to about 100 miles were obtained.

It was soon, however, realized that so long as it was possible to work only two installations within what I may call their sphere of influence, a very important limit to the practical utilization of the system was imposed. Without some practical method of tuning the stations it would have been impossible to work a number in the vicinity of each other at the same time without interference caused by the mixing of messages. The new methods of connection which I had adopted in 1898, i. e., connecting the receiving vertical wire or aerial directly to earth instead of to the coherer, and by the introduction of a proper form of oscillation transformer in conjunction with a condenser so as to form a resonator tuned to respond best to waves given out by a given length of aerial wire—were important steps in the right direction. I referred at length to this improvement in the discourse which I had the honor to deliver at this table on February 2, 1900. I had, however, realized at the time that one great difficulty in the way of achieving the desired effects was caused by the action of the transmitting wire. A straight rod in which electrical oscillations are set up forms, as is well known, a very good radiator of electrical waves. In all what we call good radiators electrical oscillations set up by the ordinary spark-discharge method cease or are damped out very rapidly, not necessarily by resistance, but by electrical radiation removing the energy in the form of electric waves.

It is a well-known fact that when one of two tuning forks having the same period of vibration is set in motion, waves will form in the air, and the other tuning fork, if in suitable proximity, will immediately begin to vibrate in unison with the first. In the same way a violin player, sounding a note on his instrument, will find a response from a certain wire in a piano nearby, that particular wire, out of all the wires of the piano, happening to be the only one which has a period of vibration identical with that of the musical note sounded by the violinist. Tuning forks and violins, of course, have to do with air waves and wireless telegraphy with ether waves, but the action in both cases is similar. It is very important to take into consideration the one essential condition which must be obtained in order that a well-marked tuning or electrical resonance may take place. Electrical resonance, like mechanical resonance, essentially depends upon the accumulated effect of a large number of small impulses properly timed. Tuning can only be obtained if a sufficient number of these timed electrical impulses reach the receiver. As Prof. Fleming so graphically puts it in one of his lectures on electrical oscillations, to "set a pendulum in vibration by puffs of air we must not only time the puffs properly, but keep on puffing for a considerable period." It is, therefore, clear that a dead-beat radiator, i. e., one that does not give a train or succession of electrical oscillations—is not suitable for tuned or syntonic space telegraphy.

As I pointed out before a transmitter consisting of a vertical wire discharging through a spark-gap is not a persistent oscillator. Its electrical capacity is comparatively so small and its capability of radiating waves so great that the oscillations which take place in it must be considerably damped. In this case receivers or resonators of a considerably different period or pitch will respond and be affected by it.

Early in 1900 I obtained very good results with another arrangement in which the radiating and resonating conductors each take the form of two concentric cylinders, the internal cylinder being earthed. By using zinc cylinders only 7 meters high and 1.5 meters in diameter good signals could easily be obtained between St. Catherine's Point, Isle of Wight, and Poole, over a distance of 30 miles, these signals not being interfered with or read by other wireless telegraph installations worked by my assistants or by the Admiralty in the immediate vicinity. The capacity of the transmitter due to the internal conductor is so large that the energy set in motion by the spark discharge cannot all radiate in one or two oscillations, but forms a train of slowly-damped oscillations, which is just what is required. A simple vertical wire may be compared with an empty teapot, which, after being heated, would cool very rapidly, and the concentric cylinder system with the same teapot filled with hot water, which would take a very much longer time to cool. In the receiver the closely adjacent cylinders which give it large electrical capacity cause it to be a resonator possessing a very decided period of its own, and it becomes no longer apt to respond to frequencies which differ from its own particular period of electrical oscillation, nor to be interfered with by stray ether waves which are sometimes caused by atmospheric disturbances, and which occasionally prove troublesome during the summer.

Another successful system of tuning or syntonizing the apparatus was the outcome of a series of experiments carried out with the discharge of condenser or Leyden jar circuits. I tried by means of associating with the radiating wire, or capacity, a condenser circuit, which is known to be a persistent oscillator, to set up the required number of oscillations in the radiator. An arrangement consisting of a circuit containing a condenser and a spark-gap constitutes a very persistent oscillator. Prof. Lodge has shown us how, by placing it near another similar circuit it is possible to demonstrate interesting effects of resonance by the experiment usually referred to as that of Lodge's syntonic jars. But, as Lodge points out, "a closed circuit such as this is a feeble radiator and a feeble absorber, so that it is not adapted for action at a distance." I very much doubt if it would be possible to effect an ordinary receiver even at a few hundred yards. It is, however, interesting to notice how easy it is to cause the energy contained in the circuit of this arrangement to radiate into space. It is sufficient to place near one of its sides a straight metal rod or good electrical radiator, the only other condition necessary for long-distance transmission being that the period of oscillation of the wire or rod should be equal to that of the nearly closed circuit. Stronger effects of radiation are obtained if the radiating conductor is partly bent round the circuit containing the condenser (so as to resemble the circuits of a transformer).

My first trials with this system were not successful, in consequence of the fact that I had not recognized the necessity of attempting to tune to the same period of electrical oscillations (or octaves) the two electrical circuits of the transmitting arrangement (these circuits being the circuit consisting of the condenser and primary of the transformer and the aerial or radiating conductor and secondary of the transformer). Unless this condition is fulfilled, the different periods of the two conductors create oscillations of a different frequency and phase in each circuit, with the result that the effects obtained are feeble and unsatisfactory on a tuned receiver. The syntonized transmitter is shown in Fig. 1. The period of oscillation of the vertical conductor, *A*, can

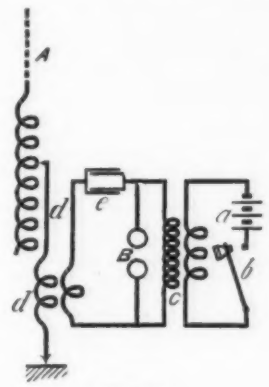


FIG. 1.

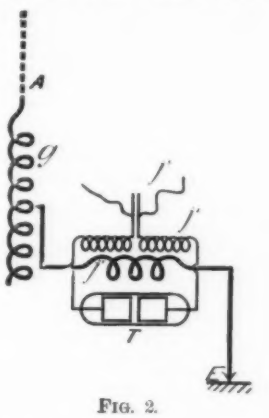


FIG. 2.

be increased by introducing turns of wire, or decreased by diminishing their number, or by introducing a condenser in series with it. The condenser in the primary circuit is constructed in such a manner as to render it possible to vary its electrical capacity.

The receiving station arrangements are shown in Fig. 2. Here we have a vertical conductor connected to earth through the primary of a transformer, the secondary circuit of which is joined to the coherer or detector. In order to make the tuning more marked, I place an adjustable condenser across the coherer in Fig. 3. Now, in order to obtain best results, it is necessary that the free period of electrical oscillation of the vertical wire primary of transformer and earth

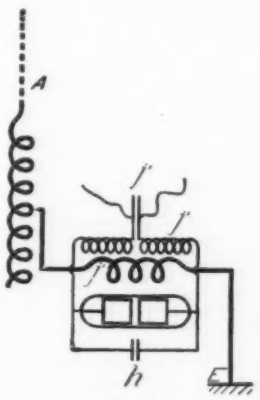


FIG. 3.

connection should be in electrical resonance with the second circuit of the transformer, which includes the condenser. I stated that in order to make the tuning more marked a condenser is placed across the coherer. This condenser increases the capacity of the secondary resonating circuit of the transformer, and in the case of a large series of comparatively feeble but properly timed electrical oscillations being received, the effect of the same is summed up until the E. M. F. at the terminals of the coherer is sufficient to break down its insulation and cause a signal to be recorded. In order that the two systems, transmitter and receiver, should be in tune it is necessary (if we assume the resistance to be very small or negligible) that the product of the capacity and inductance in all four circuits should be equal.

It is easy to understand that if we have several stations, each tuned to a different period of electrical vibration, and of which the corresponding inductance and capacity at the transmitting station are known, it will not be difficult to transmit to any one of them, without danger of the message being picked up by the other stations for which it is not intended. But better than this we can connect to the same vertical sending wire, through connections of different inductance, several differently tuned transmitters, and to the receiving vertical wires a number of corresponding receivers. Different messages can be sent by each transmitter connected to the same radiating wire simultaneously and received equally simultaneously by the vertical wire connected to differently tuned receivers. This result, which I believe was quite novel at the time, I showed to several friends of mine, including Dr. J. A. Fleming, F.R.S., nearly two years ago. Dr. Fleming made mention of the results he had seen in a letter to the London Times dated October 4, 1900. I have further noticed that the tuning can be further improved by the combination of the two systems described. In this case the cylinders are connected to the secondary of the transmitting transformer, and the receiver to a properly-tuned induction coil, and all circuits must be tuned to the same period as already described. This arrangement is going to be further tested in long-distance experiments shortly to be undertaken between England and Canada.

The syntonic systems have not been applied generally to ships, as it has always been considered an advantage that each ship should be able, especially in case of distress, to call up any other ship or ships which may happen to be at the time within the range of its transmitter, but in the case of land stations the syntonic method has been applied in several instances where necessity demanded it. Thus at the testing stations which maintain communication between St. Catherine's, Isle of Wight, and Poole, in Dorset, when electric waves of a certain frequency are used, no interference whatever can be caused by the working of the Admiralty installations in the vicinity. The long-distance station at Poldhu, Cornwall, is able to transmit signals decipherable on a tuned receiver on a ship at over 1000 miles distance, while the Lloyd's wireless station at the Lizard, only 7 miles away, is not affected by the powerful waves radiated from Poldhu if tuned to a different frequency.

I am not at all prepared to say that under no possible circumstances could a wireless message transmitted between syntonic instruments be tapped or interfered with, but I wish to point out that it is now possible to work a considerable number of wireless telegraph stations simultaneously in the vicinity of each other without the messages suffering from any interference. Of course, if a powerful transmitter, giving off waves of different frequencies, is actuated near one of the receiving stations it may prevent the reception of messages, but the ordinary systems of communication through wires may be likewise affected. Prof. O. J. Lodge, in a report of his experiments in magnetic space telegraphy, mentions that he was able to interfere with the working of the ordinary wire telephone system in the city of Liverpool. Sir W. H. Preece has also published results which go to show that it is possible to pick up at a distance on another circuit the conversation which may be passing through a telephone wire. About two years ago, at Cape Town, it was found impossible to work the cables landing there during certain hours when the electric tramways of the town were running, and the matter became subsequently the subject of litigation between the companies concerned. Prof. Fleming, who has witnessed the working of a great number of syntonic wireless telegraph stations, was sufficiently impressed by what he saw to make the following statement in his Cantor lectures on "Electrical Oscillations and Electric Waves," delivered before the Society of Arts in December, 1900: "The objections as to interference of stations which imperfectly-informed persons are in the habit of raising with regard to Mr. Marconi's system of wireless telegraphy, as a matter of fact no longer exist."

I shall now say a few words on the subject of the detector of the electric waves, called sometimes "the electric eye," which consists of that essential part of the receiving apparatus especially affected by the electrical oscillations. In all wireless telegraph apparatus used up to quite a recent date, a detector, now called a coherer, has been employed. This detector is based on discoveries and observations made by S. A. Varley, Prof. Hughes, Colzecchi, Onesti, and especially Prof. Branly. Prof. O. J. Lodge has made large use of this apparatus, which he first named "coherer," in the very numerous experiments and studies he has carried out on the effects produced by Hertzian waves. The form of coherer I have found most trustworthy and reliable for long-distance work consists of a small glass tube about 4 centimeters long, into which two metal pole-pieces are tightly fitted. They are separated from each other by a small gap, which is partly filled with a mixture of nickel and silver filings. Provided such a coherer is properly constructed, and the tapper and relay in good adjustment, it proves to be quite reliable when within the range of the transmitting station. Experiments with syntonic systems have, however, shown that certain kinds of coherers can be far more advantageously employed than others. One apparently all-important condition is that the resistance of the coherer in its sensitive state, or after being tapped, should appear to be infinite when measured with an E.M.F. of about 1 volt. If the tapping does not entirely do away with the conductivity of the filings very poor results are obtained, which can be explained as follows. According to the systems I have described, electrical syntony between the transmitter and receiver is dependent on the proper electrical resonance of the various circuits of the transformers used in the receivers. The condenser and secondary of the transformer must not be partially short-circuited by the coherer, otherwise the oscillations cannot mount up or sum up their effect, as is essential in order to produce the difference of potential at the ends of the coherer necessary for breaking down its resistance; but the electrical oscillations will leak across the con-

ductive coherer without causing it to record any signal. Of course, the condenser is short-circuited when the filings cohere under the influence of the received oscillations; but in this case the signal is already recorded, and the tapper at once restores the coherer to its non-conducting condition, and in this way restores its sensitiveness.

By using coherers containing very fine filings the necessary condition of non-conductivity when in a sensitive state is obtained. Coherers have lately been tried which will work to a certain extent satisfactorily without the necessity of employing any tapper or decoherer in connection with them. Nearly all are dependent on the use of carbon microphonic contact or contacts which possess the curious quality of partially re-acquiring spontaneously their high resistance condition after the effect of the electrical oscillations has ceased. This enables one to obtain a far greater speed of reception than is possible by means of a mechanically-tapped coherer, the inertia of the relay and tapper which are used in connection with it being necessarily sluggish in their action. In all these self-decohering coherers a telephone which is affected by the variations of the electric current caused by the changes in conductivity of the coherer is used in place of the recording instrument. It has not yet been found possible, so far as I am aware, to actuate a recording instrument or a relay by means of a self-restoring coherer. The late Prof. Hughes was the first, I believe, to experiment with and receive signals on one of these coherers associated with a telephone. His experiments were carried out as early as 1879, and I regret that this pioneer work of his is not more generally known. Other self-restoring coherers were proposed by Profs. Tommasina, Popoff, and others, but one which has given good results when syntonic effects were not aimed at was (according to official information communicated to me) designed by the technical personnel of the Italian navy. This coherer, at the request of the Italian government, I tested during numerous experiments. It consists of a glass tube containing plugs of iron with between them a globule of mercury. Lieut. Solari, who brought me this coherer, asked me to call it the "Italian Navy Coherer." Recently, however, a technical paper gave out that a signalman in the Italian navy was the inventor of the improved coherer, and I was at once accused in certain quarters of suppressing the alleged inventor's name. I therefore wrote to the Italian Minister of Marine, Admiral Morin, asking him to make an authoritative statement, to which I could refer in the course of this address, of the views of the Italian Admiralty on the matter. The head of the Italian navy was good enough to reply to me by letter, dated the 4th inst., in which he makes the following statement, which I have translated from the original Italian: "The coherer has been with good reason baptized with the name of 'Italian Navy Coherer,' as it must be considered fruit of the work of various individuals in the Royal navy and not that of one." These non-tapped coherers have not been found to be sufficiently reliable for regular or commercial work. They have a way of cohering permanently when subjected to the action of strong electrical waves or atmospheric-electrical disturbances, and have also an unpleasant tendency toward suspending action in the middle of a message. The fact that their electrical resistance is low and always varying, when in a sensitive state, causes them to be unsatisfactory for the reasons I have already enumerated when worked in connection with my system of syntonic wireless telegraphy.

These coherers are, however, useful if employed for temporary tests in which the complete accuracy of messages is not all-important, and when the attainment of syntonic effects is not aimed at. They are especially useful when using receiving vertical wires supported by kites or balloons, the variations of the height of the wires (and, therefore, of their capacity) caused by the wind making it extremely difficult to obtain good results on a syntonic receiver.

Coherers have long been considered as constituting almost the essential basis of electric space telegraphy, and although many other detectors of electric waves existed, none of them possessed a sensitiveness which even approached that of a coherer, and most of them were also unsuitable for the reception of telegraphic messages. With a view to producing a receiver which could be worked at a much higher speed than a coherer, I was fortunate enough to succeed in constructing a magnetic detector of electric waves, based on a principle essentially different from that of the coherer, and which I think leaves all coherers far behind in speed, facility of adjustment and efficiency when worked in tuned circuits. This detector, which I had the honor of describing in detail before the Royal Society yesterday, possesses I believe a sensitiveness which surpasses that of the best coherers. The magnetization and demagnetization of steel needles by the effect of electrical oscillations has long been known and was noted especially by Prof. T. Henry, Aloria, Lord Rayleigh and others. Mr. E. Rutherford also has described a magnetic detector of electric waves based on the partial demagnetization of a small core composed of fine steel needles previously magnetized to saturation. By means of a magnetometer Mr. Rutherford succeeded in 1895 in tracing the effects of his electrical radiator up to a distance of three-quarters of a mile across Cambridge. But Mr. Rutherford's arrangement is not suitable for the reception of telegraphic messages in consequence of the fact that a careful process of remagnetization, which requires some time to effect, is necessary in order to restore its sensitiveness after the receipt of each impulse. Mr. Rutherford's arrangement is also considerably less sensitive than a coherer.

The detector which I am about to describe is, in my opinion, based upon the decrease of magnetic hysteresis, which takes place in iron when under certain conditions it is exposed to the effect of high frequency oscillations or Hertzian waves. As employed by me, it has been constructed in the following manner: On a core of thin iron or steel, but preferably hard drawn iron, are wound one or two layers of thin insulated copper wire. Over this winding insulating material is placed, and over this, again, another longer winding of thin copper wire contained in a narrow bobbin. The ends of the winding nearest the iron core are connected, one to earth and the other to an elevated conductor, or they may be connected to the secondary of a suitable receiving transformer or intensifying coil, such as are employed for syntonic wireless telegraphy. The ends of the other winding are connected to the terminals of a telephone or other suitable receiving instrument. Near the ends of the core, or in close proximity to it, is placed a horseshoe magnet, which, by a clock-work arangement, is so moved or revolved as to cause a slow and constant change or successive reversals in the magnetization of the piece of iron. I have noticed that if electrical oscillations of suitable period be sent from a transmitter, rapid changes are effected in the magnetization of the iron wires, and these changes necessarily cause induced currents in the windings, which in their turn reproduce on the telephone with great clearness and distinctness the telegraphic signals which may be sent from the transmitting station. Should the magnet be removed or its movement stopped, the receiver ceases to be perceptibly affected by the electric waves even when these are generated at very short distances from the radiator.

I have had occasion to notice that the signals audible in the telephone are weakest when the poles of the rotating magnet have just passed the core, and are increasing their distance from it, while they are strongest when the magnet's poles are approaching the core. Good results have also been obtained by keeping the magnet fixed, and using an endless iron rope or core of thin wires revolving on pulleys (worked by clock-work), which cause the iron to travel through the copper wire windings, in proximity to, preferably, two horseshoe magnets with their poles close to the windings, care being taken that their poles of the same sign are adjacent. This detector has been successfully employed for some time in the reception of wireless telegraphic messages between St. Catherine's Point, Isle of Wight, and the North Haven, Poole, over a distance of 30 miles, also between Poldhu, in Cornwall, and Poole, in Dorset, over a distance of 152 miles, of which 109 are over sea and 43 over high land.

It would, no doubt, be possible to obtain signals by causing the iron core to act directly on a telephone diaphragm, and in this case the secondary winding could be omitted. This detector, as I have already stated, appears to be more sensitive and reliable than a coherer, nor does it require any of the adjustments or precautions which are necessary for the good working of the latter. It possesses a uniform and constant resistance, and, as it will work with a much lower E.M.F., the secondaries of the tuning transformers can be made to possess much less inductance, their period of oscillation being regulated by a condenser in circuit with them, which condenser may be much larger (in consequence of the smaller inductance of the circuit) than those used for the same period of oscillation in a coherer circuit, with the result that the receiving circuits can be tuned much more accurately to a particular radiator of fairly persistent electric waves. As a call, a coherer in circuit, with a relay working a bell, can always be used, and if it is found possible to make the magnetic detector record on a registering instrument (as to the possibility of which the results of recent tests have left little doubt in my mind), it may be found possible to receive wireless telegraph messages at a speed of several hundred words a minute. At present, by means of this detector, it is possible to read about 30 words per minute.

The considerations which led me to the construction of the above-described detector are the following: It is a well-known fact that, after any change has taken place in the magnetic force acting on a piece of iron, some time elapses before the corresponding change in the magnetic state of the iron is complete. If the applied magnetic force be caused to effect a cyclic variation, the corresponding induced magnetic variation in the iron will lag behind the changes in the applied force. To this tendency to lag behind Prof. Ewing has given the name of magnetic hysteresis. It has been shown also by Profs. Gerosa, Finzi and others, that the effect of alternating currents or high-frequency electrical oscillations acting upon iron is to reduce considerably the effects of magnetic hysteresis, causing the metal to respond readily to any influence which may tend to alter its magnetic condition. The effect of electrical oscillations probably is to bring about a momentary release of the molecules of iron from the constraint in which they are ordinarily held, diminishing their retentiveness and consequently decreasing the lag in the magnetic variation taking place in the iron. I therefore anticipated that the group of electrical waves emitted by each spark of a Hertzian radiator would, if caused to act upon a piece of iron which is being subjected at the same time to a slowly varying magnetic force, produce sudden variations in its magnetic hysteresis, which would cause others of a sudden or jerky nature in its magnetic condition. In other words, the magnetization of the iron, instead of slowly following the variations of the magnetic force applied, gives a sort of jump each time it is affected by the electric waves emitted by each spark of the radiator. These jerks in the magnetic condition of the iron would, I thought, cause induced currents in a coil of wire of strength sufficient to allow the signals transmitted to be detected intelligibly on a telephone, or perhaps even read on a mirror galvanometer. The results obtained go to confirm my belief that this detector can be advantageously substituted for the coherer for the purposes of long-distance space telegraphy.

During the last few years the developments in the practical appliances of my system have been exceedingly rapid. Time does not allow me to give you an account of the many cases in which it has proved its usefulness, but it may be sufficient if I mention that Lloyd's have adopted the system exclusively for use at their stations at home and abroad for a period of 14 years, and that no less than 17 liners plying across the Atlantic carry permanent installations. In more than one case recorded in the daily papers the system has been of service to vessels in distress, especially in the English Channel. No less than 40 land stations (most of which are controlled by the corporation of Lloyd's) are being equipped with the system in Great Britain and Europe, and over 40 vessels in H. M. navy carry installations. The adoption of my system in the Royal navy has brought about a certain slight change in the rig of the ships. Some naval officers believe that this change improves the ship's appearance; others think the contrary.

The Italian Armiralty, after experimenting for some time with the self-decohering coherers to which I have referred before, has informed me officially, by a letter dated May 24 last, of its decision to equip their war vessels with the same apparatus as has been successfully employed on the transatlantic liners. On these liners commercial use is made of the system for the convenience of passengers, and as an illustration of its commercial workableness I might mention that lately the "Campania" and "Lucania" of the Cunard line have been collecting as much as £60 each trip in receipts derived from passengers' wireless messages.

Nearly two years ago the facility with which communication was possible over distances of nearly 200 miles, and the improvements in syntonic methods introduced, together with the ascertained fact of the non-interference of the curvature of the earth, led me to decide to recommend the construction of a large power station in Cornwall and another one at Cape Cod, Mass., U. S. A., in order to test whether, by the employment of much greater power, it might not be possible to transmit messages across the Atlantic, and establish a trans-oceanic commercial communication which the monopoly of the Postmaster-General will not apparently permit between two stations if both are situated in Great Britain. An unfortunate accident to the masts at Cape Cod seemed likely to postpone the experiments for several months, when I came to the conclusion that while the necessary repairs there were being carried out I would use a purely temporary installation in Newfoundland for the purpose of a transatlantic experiment, from which I might, at any rate, be able to judge how far the arrangements in Cornwall had been conducted on right lines. Before describing the results it may be useful if I give a brief description of the nature of the apparatus used at the transmitting and receiving stations.

The transmitter at Poldhu was similar in principle to the syntonic one I have already described, but the elevated conductor at the transmitting station was much larger, and the potential to which it was charged very much in excess of any that had previously been employed, the amount of energy to be used in this transmitting station having been approximately determined by me prior to its erection. The transmitting elevated conductor consisted of 50 almost vertical naked copper wires, suspended at the top by a horizontal wire stretched between two poles, each 48 meters high, and placed 60 meters apart. These wires were separated from each other by a space of about a meter at the top, and, after converging together, were connected to the transmitting instruments at the bottom. The potential to which these conductors were charged during transmission was sufficient to cause sparking between the top of the said wires and an earthed conductor across a space of 30 centimeters of air. The general engineering arrangements of the electric power station erected at Poldhu for the execution of these plans and for creating the electric waves of the frequency which I desired to use were made by Dr. J. A. Fleming, F.R.S., who also devised many of the details of the appliances for producing and controlling the electric oscillations. These, together with devices introduced by me, and my special system of syntonization of inductive circuits, have provided an electric wave-generating plant more powerful than any hitherto constructed. Mr. R. N. Vyvyan and Mr. W. S. Entwistle have also greatly assisted me in the experiments carried out with the very high tension electrical apparatus employed.

The first experiments were carried out in Newfoundland last December, and every assistance and encouragement was given me by the Newfoundland government. As it was impossible at that time of the year to set up a permanent installation with poles, I carried out experiments with receivers joined to a vertical wire about 400 feet long, elevated by a kite. This gave a very great deal of trouble, as in consequence of the variations of the wind, constant variations in the electrical capacity of the wire were caused. My assistants in Cornwall had received instructions to send a succession of "S's," followed by a short message at a certain pre-arranged speed, every 10 minutes, alternating with five minutes rest during certain hours every day. Owing to the constant variations in the capacity of the aerial wire it was soon found out that an ordinary syntonic receiver was not suitable, although a number of doubtful signals were at one time recorded. I, therefore, tried various microphonic self-restoring coherers placed in the secondary circuit of a transformer, the signals being read on a telephone. With several of these coherers, signals were distinctly and accurately received, and only at the pre-arranged times, in many cases a succession of "S's" being heard distinctly although, probably in consequence of the weakness of the signals and the unreliability of the detector, no actual message could be deciphered. The coherers which gave the signals were one containing loose carbon filings, another, designed by myself, containing a mixture of carbon dust and cobalt filings, and thirdly, the "Italian Navy Coherer," containing a globule of mercury between two plugs. For the good results obtained I was very much indebted to two of my assistants, Mr. G. S. Kemp and Mr. P. W. Paget, who gave me very efficient aid during the tests, which the extremely severe weather prevailing in December in Newfoundland made exceedingly difficult to carry out.

The result of these tests was sufficient to convince myself and my assistants that, with permanent stations at both sides of the Atlantic, and by the employment of a little more power, messages could be sent across the ocean with the same facility as across much shorter distances. The experiments could not be continued or extended in consequence of the action which the cable company, which claims all telegraphic rights in Newfoundland, saw fit to take at the time. Having received a most generous invitation from the government of the Dominion of Canada to continue my operations in the Dominion, it was thought undesirable to continue the experiments in Newfoundland, where I

should have probably been landed into litigation with the telegraph company. I am glad to say that the Canadian government, on the initiation of Sir Wilfred Laurier and Mr. Fielding, has shown itself most enterprising in the matter, and not only encouraged the erection of a large station in Nova Scotia, but actually granted a subsidy of £16,000 toward the erection of this transatlantic station, the object of which is to communicate with England from the coast of Nova Scotia. It is anticipated that the Canadian station will be ready for further tests very shortly. Another station for the same purpose is being erected on the United States coast.

Toward the end of February of this year I thought it desirable to test how far the messages transmitted by the powerful station at Poldhu could be detected on board a ship. The ship selected was the "Philadelphia," of the American line. The receiving aerial conductor was fixed to the mast, the top of which was about 60 meters above sea level. As the elevated conductor was fixed, and not floating about with a kite, as in the case of the Newfoundland experiments, very good results were obtained on an ordinary syntonic receiver, similar to those I have already described, and the signals were all recorded on tape by the ordinary Morse recorder. Readable messages on tape were received up to a distance of 1551 miles from Cornwall, and indications were received as far as 2099 miles. Most of the messages were received in the presence of the captain or the chief officer of the ship, who were good enough to sign the tapes. I have some of these tapes here, in a frame, and they can be examined at the conclusion of my discourse. It is curious to observe that signals could not be received at over 900 miles by any of the self-restoring coherers. The reason for this lies probably in the fact that the tuned receiver when connected to a fixed aerial is more efficient. Another result of considerable scientific interest was that at distances of over 700 miles the signals transmitted during the day failed entirely, while those sent at night remained, as I have stated, quite strong up to 1551 miles, and were even decipherable up to a distance of 2099 miles. This result, which I had the honor of describing before the Royal Society yesterday afternoon, may be due to the dis-electrification of the very highly charged transmitting elevated conductor operated by the influence of daylight.

I regret time does not permit me to give you the views which have been expressed with reference to this phenomenon. I do not think, however, that the effect of daylight will be to confine the working of transatlantic wireless telegraphy to the hours of darkness, as sufficient sending energy can be used during daytime, at the transmitting station, to make up for the loss of range of the signals, and therefore this business of communicating across the Atlantic will not be one of those works of darkness with which some people connected with cable companies would seem disposed to class it. It is, however, probable that had I known of this effect of light at the time of the Newfoundland experiments, and had tried receiving at night-time, the results would have been much better than those that were obtained.

The day is rapidly approaching when ships will be able to be in touch and communication with the shore across all oceans, and the quiet and isolation from the outside world which it is still possible to enjoy on board ship will, I fear, soon be things of the past. However great may be the importance of wireless telegraphy to ships and shipping, I believe it will be of even greater importance to the world if found workable and applicable over such great distances as those which divide Great Britain from her colonies and from America. Any of those who have lived in the colonies will easily appreciate what a hardship it is to have to wait, perhaps, four or five weeks before receiving an answer to a letter sent home. The cable rates are at present prohibitive to a vast majority of people. May it not, perhaps, be for wireless telegraphy to supply the want?

I apologize for having kept you so long, but I cannot help reading you, in conclusion, a short extract from a leading article in the London Times of Saturday, December 21, 1901, published at the time of the Newfoundland experiments. And I do so because it expresses in language of admirable clearness the sentiments with which I myself regard this subject: "It would probably be difficult to exaggerate the good effect of wireless telegraphy if, as Mr. Marconi and Mr. Edison evidently believe, and as the Anglo-American Company evidently fear, it can at no distant time be developed into a commercial success. The expense of telegraphy to distant countries is at present prohibitory to vast numbers of people, and even those who use it do so only in respect of matters of great urgency, or in which large money interests are at stake. The reason of the high charges must be sought, of course, in the enormous costliness of the plant, both in its original construction and in its maintenance and repair. A system of aerial telegraphy which would not require an expensive plant, and through which, therefore, messages might be sent at moderate rates, would soon become a potent agent in cementing those ties between Great Britain and the colonies which other recent events have done so much to strengthen and even to create. A system of comparatively cheap telegraphs would do for the British Empire very much what was done by the penny post for the United Kingdom. The pathetic story of Rowland Hill, whose efforts to establish cheap postage originated in the sympathy he felt for a poor girl in a Cumberland village who was unable to pay the sum demanded for a letter from her brother in a distant county, relates an event which in principle may be repeated to-day in many parts of the world. A cheap telegraph service would unite families, however scattered, would keep the dispersed members in close and constant touch with the old home, and would cement friendships between our own people and the colonial nations, besides forging another link in the ties which bind this country to the United States."

Court Jek Ink.—The following recipe (British secret) furnishes an excellent ink, which is sold at a high price under the name of Court Jek (Court Ink?): Mix ground gall nuts 500 grammes, powdered gum arabic 80 grammes, powdered alum 36 grammes, green vitriol 120 grammes, glycerine 36 grammes, logwood 48 grammes, and 4 kilos of water. Boil for three quarters of an hour and filter. This ink can be copied.—Färber und Wäscher.

A REVIEW OF ALLOYS.*

THE ordinary method of obtaining alloys is by melting together the different constituents. However, alloys can also be obtained by subjecting the powders of the constituent metals to strong compression. It has furthermore been found that the molecules of metals penetrate each other when in contact, at temperatures far below the melting point of either of the constituents, some time to be alloyed with quantities of the above metals, the amount of which in the lead decreases with the distance from the plane of contact. That metallic alloys can be obtained by electro-deposition from their solutions is a well-known fact, but hardly applied otherwise than for purposes of electroplating.

In combining different metals with each other, a few rules may be laid down regarding the qualities of the alloy, though it must be stated that, like most rules, they do not apply absolutely to every case. By adding one metal to another, the strength of the latter is generally increased up to a certain point dependent upon the nature of the metal added. After going beyond this limit, a decrease in strength takes place again, frequently very rapidly, unless the metal added possesses greater strength than the one to which it has been added. Tin, aluminium or zinc added to copper are examples of the correctness of this rule. By adding a third metal, not infrequently a further increase in strength can be accomplished. The hardness of a metal also generally increases by adding another metal. An alloy of 95 per cent copper and 5 per cent tin possesses double the hardness of pure copper. The ductility of metals is generally greater, the purer they are. The temperature is of some influence; copper and zinc are more ductile at a high temperature, while the ductility of brass and German silver decreases with a rise of temperature. The fusing point of a metal is generally lowered by alloying it with another. Alloying one metal with another in most cases decreases the conductivity for heat and electricity.

Copper and tin will unite to form homogeneous alloys in a wide range of proportions. As tin is added to pure copper the color of the alloy gradually changes, becoming decidedly yellow at 10 per cent, and turning to gray as the proportion approaches 30 per cent. In the researches conducted by the author, it was found that good alloys contain as much as 20 per cent tin. When the color changes from golden yellow to gray and white, the strength as suddenly diminishes; and alloys containing 25 per cent tin are valueless to the engineer; nevertheless, this alloy and those containing up to 30 per cent show compressive resistances increasing to a maximum. Under 17.5 per cent, the elastic limit lies between 50 and 60 per cent of the ultimate strength; beyond this percentage the proportion rises, and at 25 per cent tin the elastic limit and breaking point coincide. Passing 40 per cent tin this change is reversed and the elastic limit, although indefinite, is lowered until pure tin is reached and a minimum at about 30 per cent.

The bronzes useful to the engineer contain between 85 and 91 per cent copper and 15 to 9 per cent tin. A small addition of a deoxidizing agent like phosphorus, silicon, manganese, aluminium greatly increases the strength of a bronze. Copper and zinc together form brass, which is usually made nearly in the proportion copper 66 2-3, zinc 33 1-3.

Brass may be made tough or soft, hard or brittle, strong or weak, elastic or inelastic, dull of surface or lustrous as a mirror, friable or nearly as malleable and ductile as lead, as may be desired, by varying its composition. No known material, perhaps not even excepting iron, can be given so wide a range of quality or so wonderful a variety of uses. All the common varieties are composed of 67 to 70 parts copper and 33 to 30 of zinc. A little lead is often added to soften and cheapen it and tin in small proportion to strengthen it. The copper-tin-zinc alloys or kaichoids (from the Greek "kaichos," indicating bronze or brass) are of great value, and include the strongest and probably the hardest possible combinations. They are in most respects, usually, intermediate between the brasses and the bronzes obtained by uniting two metals.

On making a large series of tests with compositions of the three metals named, Prof. Thurston finally arrived at the conclusion that the best alloys for purposes demanding toughness as well as strength lay between 58 and 54 per cent copper, 44 and 40 per cent zinc, and 2½ and ½ per cent tin. It was found that the strongest of bronzes contained 57 per cent copper, 1 per cent tin, and 42 per cent zinc; however, an alloy of the composition 56 per cent copper, 2 per cent tin, 42 per cent zinc is likely to prove more generally useful, in consequence of its greater ductility and resilience, and alloys with a little less tin may often prove better than that. The safest alloys under shock are those containing the smallest quantities of tin. By far the most ductile alloy of this series tested contained no tin at all and had the composition 57 per cent copper and 43 per cent zinc.

A discussion on the properties of alloys would be incomplete were the influence of small quantities of impurities upon metals not considered in this connection. We all know of the deleterious effect which small quantities of phosphorus and sulphur exert upon the quality of iron and steel. One-tenth of a per cent of antimony, bismuth or arsenic in copper or brass will make it absolutely impossible to roll these metals into sheets, due to their cracking under the rolls. The electrical conductivity of copper is materially diminished by minute quantities of impurities; on the other hand, it has been found by the "Alloys Research Committee" that a small quantity of arsenic is actually beneficial in copper used for fireboxes and staybolts. Two-tenths of a per cent of lead, bismuth or antimony added to gold will make this most ductile of all metals so brittle that it can be shattered with the greatest of ease; a small quantity of arsenic in tin will transform this soft metal into a very hard and brittle one, etc.

I wish to add here a few observations made in my laboratory as regards the influence of small quantities of impurities upon the qualities of certain antifriction metals. A small quantity of zinc, from 5-100 to 1-10 of a per cent, in a lead-antimony-tin alloy, will greatly interfere with the obtaining of clean castings, due to the great tendency of forming oxides or drossing. A similar phenomenon is caused by the presence of 1-10 to 2-10 of a per cent of iron in a tin-copper-antimony alloy. A small quantity of arsenic in either of these alloys will cause large, lamellar and brittle crystals to be formed, which made the metals useless for the purposes they are intended for.

An attempt will now be made to show how considerations along lines as indicated above have contributed to our understanding of the nature of alloys. We all know that by dissolving common salt in water we lower the freezing point of the water. By increasing the amount of salt the freezing point of the resulting mixture is at first correspondingly lowered until it contains a certain percentage of salt. The lowest possible freezing point of a solution of salt in water is then reached and further addition of salt will gradually raise the freezing point of the brine. Dr. Guthrie found that the mixture which has the lowest possible freezing point contains about 23.5 per cent of salt. He proposed for it, and for all similar mixtures, i. e., for all saline solutions of lowest freezing points, the name of cryohydrate, by which he meant to imply that they can only exist in a solid state at low temperature.

The present theory of the constitution of alloys, worked out on the basis of the theory of solutions, ranges them into three classes: 1. Alloys which give neither definite compounds nor isomorphous mixtures. 2. Alloys which form definite compounds. 3. Alloys which form isomorphous mixtures. Into the first group belong the alloys of lead and antimony, lead and tin, copper and silver, etc.

Taking the curve of fusibility of antimony and lead as an example, we find that the lowest fusing point lies at 228 deg. C. with a composition of 13 per cent antimony and 87 per cent lead.

The similarity between this curve of fusibility and the curve of solubility of a saline solution is obvious. If a molten alloy of lead and antimony containing less than 13 per cent antimony is allowed to solidify slowly, lead will first start to crystallize out until the temperature has fallen to 228 deg. C., when the temperature will remain constant until the total mass of the alloy is solidified. If, on the other hand, more than 13 per cent of antimony is present in the alloy, the antimony will solidify first until on cooling to 228 deg. C. the lead and antimony will solidify together in the proportion of 87 to 13. From this may be easily observed the absolute similarity between the cryohydrate and the alloy of the lowest possible melting point, and for this latter Dr. Guthrie has proposed the name eutectic alloy.

Into the second group, alloys which form definite compounds, belong the tin-copper, antimony-copper, aluminium-gold, aluminium-antimony alloys and others.

In the case of alloys containing less than 25 per cent of copper, pure crystals of antimony are separated when solidification begins, increasing gradually in size as the temperature decreases; the portion remaining liquid, therefore, gradually becomes richer in copper until the composition of the eutectic alloy is reached; it then solidifies, at a constant temperature, through a simultaneous crystallization of antimony and $SbCu_2$. In the case of alloys containing from 25 to 60 per cent of copper, a similar phenomenon occurs, only it is the definite compound $SbCu_2$ which separates from the molten mass as soon as the freezing point is reached. When from 60 to 70 per cent of copper is present, the same compound is separated, but it is in this case surrounded by a second eutectic alloy made up of copper and the compound $SbCu_2$. Finally, when more than 70 per cent of copper is present, a portion of the latter is first deposited when solidification sets in, until the portion remaining liquid has reached the composition of the second eutectic alloy.

In the third group, alloys which form isomorphous mixtures, belong the alloys of silver and gold and of bismuth and antimony. The curve of fusibility of these alloys is the simplest imaginable, consisting merely of a straight line drawn between the two melting points of the respective metals.

In this case there is no eutectic alloy, as the whole mass solidifies at a constant temperature, which is a function of the composition.

All these conclusions drawn from the curves of fusibility have been corroborated by microscopic and analytical evidence, and a very large number of beautiful photomicrographs have been published by the above-named investigators. It might be mentioned in passing that the joint application of caloric and microscopic methods of investigation on iron and steel have contributed greatly to our understanding of the molecular constitution of these metals, the changes of the molecular arrangement on tempering, etc.

Bearing Metals.—A group of alloys of especial interest to the railroad man are the bearing metals. In 1892 Dr. Dudley published a report in which he condemned the use of gun bronze, quite generally employed in axle bearings at that time, and advocated the substitution of it by a bearing containing besides copper, tin and a small percentage of phosphorus, a quantity of 10 to 15 per cent lead, on the grounds that such an alloy was very much less liable to heating than cannon bronze and wore about 50 per cent less.

The conclusions he drew from a large number of tests were the following: 1. The loss of metal by wear under exactly the same conditions diminishes with the increase of lead. 2. The loss of metal by wear diminishes with the diminution of tin. 3. Phosphorus in a copper-tin-antimony alloy is more valuable in the foundry than in service. Its principal value lies in the help it gives in getting sound castings.

Dr. Dudley then proceeds to state that it is impossible to use white metal alloys for solid bearings, on account of the distortion they suffer in service due to

* Extracts from a paper presented before the April meeting of the Western Railway Club by Gustav Thurnauer, Ph.D., Ampere Metal Company.

their plasticity, but he adds if provided with a stiff backing there is no reason why they should not give very satisfactory results.

The latest and most extensive work on antifriction alloys was published in 1898 in a very comprehensive paper by Dr. Charpy, in which he describes how, with the aid of the microscopic structure of the metals, the curves of fusibility and tests of compression, he was able to determine the composition of alloys best adapted for the purposes of antifriction metals. His manner of reasoning was as follows: Experiments have demonstrated very conclusively that the coefficient of friction in the case of a well-adjusted bearing depends exclusively upon the nature of the lubricant, regardless of the metals in contact. Furthermore, while for small loads without lubrication the coefficient of friction is practically constant, it increases in proportion to the pressure up to a certain point, above which the increase is very rapid, the surfaces rubbing together producing heat and finally cutting. Theoretically all bearings should be as hard as possible, as they will bear the heaviest load without materially increasing the coefficient of friction. In practice, however, bearings of this kind would be absolutely useless, as a constantly perfect adjustment cannot be obtained, and therefore a certain plasticity of the bearings is necessary. Alloys used for bearings should therefore have two apparently contradictory properties, i. e., hardness and plasticity. Such properties can be obtained in white metal alloys composed of hard grains embedded in a plastic cement. All alloys used for antifriction purposes should possess the same general characteristics; they should consist of hard grains embedded in a plastic alloy. Such constitution may be produced in binary alloys, the hard grains being made up of a single metal such as antimony. It is generally preferable, however, to use ternary mixtures, because, owing to the complex composition of the cement, the constitution possessing the required qualities may be more readily obtained. Such alloys are the tin-antimony-copper alloys (genuine babbitts) and the lead-antimony-tin alloys, both of which have been found empirically to be best suited for the purposes of antifriction metals.

THE GANNETS OF THE BASS.*

ONE of the oldest and most respected families in Scotland is that of the Gannets of the Bass Rock. Their shield bears, for device, a Solan goose descendant, transfixing a herring nageant, with motto "De profundis resurgam." A branch of the clan has settled at Ailsa Craig, on the opposite, that is to say the western, side of Scotland, and there is a vast colony at North Brora, in the Outer Hebrides, at St. Kilda, and elsewhere, but for the most part the cadets are very faithful to the ancient ancestral seat on the Bass Rock.

Certainly there is not another family in the kingdom whose members lead a life of more uniform regularity; and yet their habit of spending the winter months away from the rock fortress that is their home, and for the most part in a southern and sunny clime, is a departure from the best Caledonian traditions. But the times of their coming and their going seem to be fixed as firmly as the movements of the planets. From November 1 to March 1 there is not such a creature as a gannet on the Bass Rock or its immediate vicinity. On March 1, almost invariably to the very day, the first comers are to be seen on their accustomed seats on the terraces of the cliffs, and shortly all the turmoil of the nesting business begins. The turmoil is very great. This is eminently one of the places that ought to occupy the grave attention of the Congested Districts Board. The terraces are limited in extent, and often very narrow. The hustling and the bustling of which they are the scene at the right season—that is to say, at the time that the birds are selecting (it would be wrong to say building, for they do no building) their nests—scarcely is to be imagined. No doubt the population is increasing, while there is no corresponding increase in house room for its accommo'ation, with the natural consequence that the housewives fall out, in situations where the falling out of two almost necessarily means the falling off—off the narrow ledge—of one.

The gannet has very few breeding-places, and probably its choice is directed by the fact that it is incapable of rising from the level ground. Off the sea it can arise with ease, but its only means of launching itself into the air from *terra firma* is to arrive at an edge of a cliff over which it can throw itself, and so find space to spread its immense pinions (the gannet is six feet two inches from wing tip to wing tip) for flight. This is best seen by a visit to the rock when the birds are sitting on their eggs. It requires a steady hand, even with a rope's aid, to visit the ledges where the mother brings up the single bird that composes her family. Their indifference to your approach is remarkable. They will permit you to come right up to them and roll them over with your foot. Then they fall, in a curiously stiff, lopsided way, as if they were dead and stuffed, over the edge of the cliff, and so vanish from your sight. You see nothing for a second or two, but you know that the bird is falling all the while, hidden from your view, down toward the water. Your next glimpse shows the creature spreading its great wings inward to the rock again, and again, for a surprising length of time as it seems to you, waiting, it is lost to your sight, till suddenly it reappears, coming like a Jack-in-the-box over the cliff edge close by you, and plumps down instantly, the force of its upward flight being calculated to a wonderful nicety, precisely on the spot from which you had pushed it off. The bird must have its landmarks or signal-posts up the cliffside, by which it knows precisely where it has to top the precipice in order to arrive at its own place. A little farther along the same ledge, perhaps, may be a young gannet, just a fluff of gray down with two eyes and an immense hungry mouth. These babies express their sentiments on the approach of any human visitor by throwing up every atom of food—and most unsavory it is—that they have within them, a singular arrangement of Nature, of which one does not readily see the explanation.

The gray fluff is the plumage of the nestlings, nor is it till the fifth year that the gannets acquire the magnificent adult dress of white with the black-tipped pinion feathers. Each successive moult brings them a little nearer to it, sable and snowy plumes taking gradually the place of less distinguished and more monotonous colorings. Generally it is in their full-grown beauty that we are familiar with them sailing easily with slow sweeps of their wide wings, over the ocean, then stopping a moment, hovering, as they mark out the herring in the sea beneath that they will transfix as they plunge down upon it, anon descending with wings closed, like a stone into the water, sending up a shower of foam, such as is raised by the firing of a submarine mine; then, after a moment or two, slowly rising again into the air, swallowing as they go the fish they have caught. There are those who will tell you that they have seen the gannets killed by means of trailing, with a long string, behind a boat, a board, colored to the sea's hue, on which a herring was fastened. The bird diving at the fish strikes and breaks its neck upon the unsuspected board. There are those who will tell you they have seen this, and, without doubt, they speak truth.

A FAVORITE NESTING PLACE.

The present writer can but tell you he has seen trial made of the plan often, but no gannet has "seemed one penny the worse." The fact that so large a percentage of the birds that we watch fishing in this characteristic manner are equipped with all their full-grown plumage would indicate that they are a long-lived race, the proportion of those that wear the juvenile dress of four years old and under being so small that it is seldom noticed by the casual observer. The male is always slightly larger than the female, but he is to be distinguished more easily by a shade of brown that he retains always among the predominating white on the head. Birds born in any one year do not return to the rock nursery until August of the following season, and what their object is in resorting to it at that time must remain matter for conjecture, since they do not take part in the great business of nesting. But there they stay and fish in the neighborhood of the home of their infancy until, in November, they join the general southward migration which leads the birds as far south as Madeira and the Canaries for their winter season.

The gannet, with his six feet and more of wing stretch and his formidable beak, resembling in miniature the type of the great pelican tribe to which he belongs, has reason to fear no foe. The skua that hunts the gulls till they drop their food thinks best to leave him unmolested. He makes his journeys over the sea, as we are told, partly by flight and partly by swimming; chiefly, we may conclude it probable, by the former method, using the water as his resting-place when he is weary; for in spite of his webbed feet he does not seem to employ them much for locomotion. They bring him up, no doubt, to the surface after his dive, but in his search for his meals and his goings to and fro his wing power serves him ably and sufficiently.

A lighthouse, just completed, is on the point of being lighted for the first time on the side of the Bass Rock remote from the birds' nesting-place. It will be curious to see, on their return from their winter quarters, whether these oldest inhabitants will show any resentment toward the new luminary.

* Country Life.

SOARING GANNETS.

THE CROWNING OF A KING.

THE coronation service at Westminster will be full of quaint mediæval symbolism. The climax is, of course, reached when the crown is actually placed on the monarch's head. But there are many ceremonies to be gone through before that is reached. The sovereign enters the Abbey by the west door, and takes his place on a chair placed before the throne. The ceremony known as the recognition is first performed, in which the officiating archbishop presents the sovereign to those present, and asks if they are willing to do homage, whereupon the people call out "God save the King," and the trumpets sound. The king goes to his chair on the south side of the altar and kneels at his fald-stools. The Litany, Ante-Communion service and sermon follow, when the oath is administered on the Great Bible, which has been carried in the procession. The archbishop next anoints the sovereign, who has now taken his seat in St. Edward's chair, with consecrated oil, making the sign of the cross on his head and hands. Then the spurs are brought from the altar and presented to the sovereign, and a sword is handed to him by the archbishop, which sword is afterward offered as an oblation, and then redeemed by the price of it being paid. Then with equal ceremony the sovereign is invested with the royal robe and presented with the orb, the latter of which is restored and again placed on the altar. The ring is next placed on the sovereign's forefinger, and a pair of "rich gloves" having been presented, the archbishop delivers the scepter with the cross into the sovereign's right hand, and the rod with the dove into the sovereign's left hand. Now comes the actual crowning. The archbishop, standing before the altar, takes the crown in his hands, and, laying it again on the altar, says a Collect asking for a blessing on the sovereign about to be crowned. The Dean of Westminster brings the crown from the altar, and the archbishop takes it from him and reverently places

it on the king's head. At this point the people acclaim their newly crowned sovereign with shouts of "God save the King," and the guns at the Tower fire a salute. Immediately after the crowning the peers and peeresses put on their coronets and the bishops their miters. Then follow the presentation of the Holy Bible, the benediction and the Te Deum. That done, the archbishop delivers an exhortation to the sovereign, who has taken his seat on the throne, and the ceremony of homage begins. The first to do homage are the archbishops and bishops. After these come the other peers, the dukes by themselves, then the marquesses, the earls, the viscounts and the barons severally. The peers remove their coronets while doing homage. When this ceremony is over, the drums beat, the trumpets are blown, and the people cry out "God save King ——." This concludes the actual coronation ritual, which is followed by the communion service, in which the sovereign makes an oblation consisting of an altar cloth and a wedge of gold weighing a pound.

VALUABLE ANIMALS IN THE NATIONAL ZOOLOGICAL PARK.

THE National Zoological Park at Washington, D. C., was established for the purpose of collecting and preserving the animals of our own country, particularly those of the North and West, which are in danger of extinction. The importance of such animal preserves can hardly be overestimated. Some of our most valuable animals must shortly follow the sad fate of the bison unless proper legislative action interferes in their behalf. The moose, which but a few years ago was so abundantly found in the forests of Maine, was for a time threatened with extinction, and has now been largely driven from these parts into the most impenetrable regions of Nova Scotia and British America. This noble animal is the largest and most powerful of the elk tribe, sometimes attaining a height of seven feet and a weight of ten or eleven hundred pounds. Its general appearance is very awkward, as is also its gait, which is a sort of a slow, shambling pace. When hunting the moose it must be approached to the leeward, for it is very keen-scented and quickly detects the approach of an enemy. Its horns are seldom used in fighting, but the animal makes good use of his forelegs to keep back the foe. The sweet, tender twigs of the maple, yellow birch, willow, and particularly of the moosewood, form the principal food of these animals. Our illustration shows a fine specimen of a young bull moose now at the National Zoological Park.

In our other illustration is shown an animal rarely found in captivity. It was only by continued and most persistent efforts that a single Rocky Mountain sheep was captured in western Colorado. This specimen was successfully transported to Washington, and is now in a healthy condition and becoming accustomed to its new environment. These sheep, as their name implies, are found in the region of the Rockies, frequenting the most inaccessible localities. Though these animals were originally of the most trusting disposition, being almost as tame as domestic sheep, they have now grown very wild indeed. When pursued they warn their companions of danger by uttering a hissing sound, and their wonderful agility in climbing the rugged mountain sides renders futile any attempt to capture them. Grassy knolls sheltered by steep rocks form their favorite retreat and feeding places. During the greater part of the year the females and young rams leave the old rams and feed in separate herds together. The flesh of these sheep is very tender and sweet, exceeding in flavor the best of mutton.

YOUNG MOUNTAIN SHEEP FROM COLORADO, NATIONAL ZOOLOGICAL PARK.

CHALK OF SOUTHERN ARKANSAS.

THE chalk and chalk-marl deposits of southwestern Arkansas, says Mr. Joseph A. Taff, in Part III. of the Twenty-second Annual Report of the United States Geological Survey, now in press, were first described by Mr. Robt. T. Hill in the Annual Report of the Geological Survey of Arkansas for 1888, in which volume Dr. J. C. Branner, then State Geologist of Arkansas, briefly described the manufacture of Portland cement and showed that the chalk deposits compared favorably with the best English chalk as Portland cement materials. The publications of the Arkansas Survey called attention to these chalk deposits and as a result an extensive Portland cement plant was established at Whitecliffs. This development caused greater interest in the Arkansas chalk deposits, creating further demand for information.

The chalk deposits of southwestern Arkansas occur in a low rolling plain from the vicinity of Rocky Comfort, about 50 miles from the State line, northeastward toward Arkadelphia. It is the northeastward part of the great chalk formation which extends from central Texas into Arkansas. The purer chalk outcrops in three separate areas, (1) at Rocky Comfort in Little River County, (2) Whitecliffs in Little River and Sevier counties, and (3) eastward from Saline Landing in Howard and Hempstead counties. The chalks in these areas belong to the same formation and are separated by later deposits of gravel and sand.

The pure chalk formation has a variable thickness from more than 100 feet in the western part of the area to thin deposits in the eastern part. It occurs in the midst of fine chalky and clay marls into which it grades with gradual change. Throughout its occurrence it is well exposed and suitably located for exploitation. The Rocky Comfort chalk lies within one mile of the Arkansas and Choctaw Railroad, which extends westward from the main line of the Kansas City Southern at Ashdown. The Whitecliffs chalk outcrops in cliffs and bluffs above Little River, where it is well and conveniently exposed for use in the manufacture of cement near the cement works. A branch road connects the Whitecliffs deposits with the main line of the Kansas City Southern Railroad at Wilton. The Saline Landing area lies between the Arkansas and Louisiana and West Saline River, and ten miles from the main line of the St. Louis, Iron Mountain and Southern Railroad. The chalk at Saline Landing is at the head of navigation for small steamers on the Saline River and is separated from the chalk at Whitecliffs by a space of about 4½ miles.

Lying above the pure chalk of the Whitecliffs formation and separated from it by nearly 200 feet of marls, there is a formation of chalk-marl known as the Saratoga chalk-marl. This formation occurs in three separate areas, one extending from the vicinity of Saline Landing northeastward beyond Washington, another in the region of Okolona, and a third in the Deciper Creek valleys near Arkadelphia. This chalk marl formation resembles closely the lower and more sandy portion of the Whitecliffs chalk. This formation continues throughout its known occurrence with little variation in thickness of about forty feet.

Mr. Taff's report discusses briefly the nature of natural and Portland cements and their methods of manufacture, giving analyses of both natural and Portland cements, also of the various chalks, marls and clays in the Arkansas region which show that a considerable part of the chalk deposits in Arkansas approach very closely in composition to natural and Portland cement limestones which have been utilized in France and in the eastern part of the United States. A large part of the chalk, however, is shown to rival the purest chalks in England which have been used in the manufacture of the highest grades of Portland cement. To the pure chalk for Portland cement, it is necessary to add clays or marls carrying a large percentage of clay. Clays of the very best grade are found in the tertiary deposits lying immediately south of this region and further east along the St. Louis, Iron Mountain and Southern Railroad toward Little Rock. The fine textured marls which occur here associated with the chalks are shown by their analysis to contain clays adequate when mixed with the chalk to produce a proper combination for a high grade of Portland cement. It is evident that there is sufficient chalk and marl in the Arkansas region to produce an unlimited amount of Portland cement.

The nearest Portland cement manufactories occur in north Texas and Kansas, leaving the whole region of Indian Territory, Oklahoma, Arkansas, a large part of Louisiana, and other Southern States east of the Mississippi, which could be supplied with little competition by the Arkansas cements. Transportation north and south is direct by the Kansas City Southern, northeast and southwest by the St. Louis and Iron Mountain, and east and west by the Choctaw, Oklahoma and Gulf, and the Memphis and Choctaw railroads.

CHINA'S UNBANDAGED FEET.

AN Imperial edict published in the Pekin Gazette on February 1 says:

"The Chinese women for the most part have followed for a long time the custom of footbinding which is an injury to the good order of creation. Hereafter let the officials and gentry all exert themselves gently to persuade and lead the people and cause them all to understand, in the hope that this old custom may be gradually abolished."

The reigning dynasty in China has for centuries been Manchu and the Manchus have never been addicted to the practice of footbinding. The Empress Dowager therefore in giving her influence to reform in this respect is not treading on the toes of any of her own people.

It is appalling to think that hundreds of thousands of women in China are crippled for life by the practice of footbinding. This custom does not prevail among the lower classes. Poor girls need to work for a living and their efficiency would be almost destroyed if they were compelled to hobble through life on mere stumps of feet. It is the wealthy and well-to-do who subject their daughters to this terrible mutilation and the reason for it is that the Chinese are very jealous of their women and very fearful that they will go astray.

The Chinese missionary, A. H. Smith, wrote a while ago that as soon as a Chinese girl becomes of marriageable age she is proverbially a commodity as "dangerous as smuggled salt." When once she is betrothed she is kept far more secluded than ever before. The smallest and most innocent circumstance is sufficient to start vicious and malevolent gossip and it is a social axiom that scandals cluster about a widow's door.

According to all accounts the evil of foot compression in China is mitigated to some extent by the fact that little or no pain is associated with the process by which the deformity is caused. The feet are bound when the baby is only a few days old.

The bones are extremely soft, the little feet are scarcely more than a mass of pulp and compression simply arrests development. It certainly causes some discomfort; but physicians say that acute pain is not involved in the process.

The Pekin government has also declared itself in favor of another remarkable innovation. For ages there has been no intermarriage between the Manchu and the Chinese people. The hundreds of millions of Chinese have permitted themselves to be governed

YOUNG BULL MOOSE, NATIONAL ZOOLOGICAL PARK.

by the Manchus, though a sharp line of demarkation has separated them into two distinct peoples.

The imperial edict goes on to explain that the original reason why intermarriage between the Manchus and the Chinese was prohibited when the Manchu dynasty came into power was that the customs and speech of the two peoples were considerably unlike and therefore it was thought best to keep them distinct.

"Now, however," says the edict, "customs and beliefs are alike, and more than 200 years having passed, we ought to defer to the general feeling and remove the prohibition. We, therefore, command that Manchus and Chinese, whether officials or people, be allowed to intermarry. Let there be no bigoted adherence to old custom."

The edict, however, makes it clear that the government wishes to avoid too far-reaching reforms.

"At the times for selecting girls for palace attendants," continues the edict, "the Manchus must still be chosen. There must not be any selection of Chinese, lest we fall into the corrupt practices of the former Ming dynasty. We, therefore, make this restriction out of deference to the feelings of the Chinese people."

The emperor's attendants will, therefore, continue to be Manchus. It would be an innovation indeed if the palace grounds were permitted to be overrun with Chinese.

APPLIED BOTANY, RETROSPECTIVE AND PROSPECTIVE.*

IT has been the general practice in past years for the retiring Vice-President of this Section to give a summary of the results accomplished in research work, and to point out the lines along which there appears promise of further advancement. The facts set forth in these addresses and the opportunities pointed out in them have proved of great advantage to all, especially the younger men, who draw their inspiration from what has been accomplished in the past and what the future holds forth. In choosing my subject, I have deviated somewhat from the usual practice heretofore followed, not because I have anything particularly new to say or any particularly startling facts to disclose, but rather for the reason that it seems desirable at this time to emphasize some of the things that appeal to us as possibly having a marked influence on the future development of botanical work. To one who is necessarily thrown in contact with the somewhat hurly-burly affairs of life, the old meaning of botanical work is gradually giving way to something else—something that reaches out into practical affairs and pushes its way into paths where, a few years ago, the botanist would have feared to tread.

Now the question arises, is botanical science to suffer by this movement, or is it, after the first preliminary efforts, to emerge rehabilitated, stronger and more vital than ever before? I have neither fear nor doubt as to the outcome, and believe that the spirit which has made us commercially a leader of nations will enable us to build up a science which neither time nor change can seriously affect. It hardly needs any extended statement to call to mind the rapid changes which have taken place in botanical work and botanical thought during the past twenty years, yet a critical study of these changes is, to me, one of the most hopeful signs that our progress has constantly been in the direction of a stronger place in the world's usefulness and a higher plane of scientific thought. Twenty years ago the botany taught in our universities and colleges was of such a nature as to meet the general requirements of the time. It broadened out rapidly during the last ten years of this period, but it was still limited in large part to systematic studies, with some few attempts here and there to enter the field of morphology, physiology, and the kindred branches. Perhaps no one thing has given a greater stimulus to applied botany than the organization of the various State Experiment Stations, under what is known as the Hatch Act, which became a law in 1886 and went into active operation a year later. Under the broad authority given in this Act, establishing a Station in each State and Territory, opportunities were afforded for advanced studies of both plants and animals in their bearing on agricultural development, and as a result there was an extraordinary demand for men, which, even yet, it is impossible to meet.

Coincident with the establishment of the Experiment Stations came a broadening of the work of the National Department of Agriculture, thus creating the need for still more men trained in certain lines. At this time the era of specialization was scarcely upon us, but such was the demand for men and work that the stimulus to those engaged in special lines was great.

Of course, this country was not alone in the movement which has just been described, for in Europe, and particularly in France, there was experienced the same need for help in applied lines, and as a result extraordinary efforts were put forth by those in charge of chairs in the various institutions of learning to meet these demands. The happenings such as we are describing are met with frequently in the progress of the world, and are really the culmination of more or less subjective thought, which, when the proper moment arrives, breaks into force and makes itself felt in an objective way. It is found, therefore, that while this work was making rapid strides, the demand was so great for immediate practical results that sufficient attention was not always given to that accuracy and precision of conclusion that the world's best thought demands. There was a proneness, in other words, to sacrifice accuracy to utility. Helmholtz, long ago, sounded a warning on this subject, when he said that "Whoever in the pursuit of science seeks after immediate practical utility may generally rest assured that he will seek in vain." On the other hand, there is a class of investigators, and their numbers are considerable, whose work, for the most part, is largely ahead of the practical side. Possibly, taking all of the work that has been done in this country, the need is not so much for more research, but for the practical application of the researches already made to the everyday affairs of life. In some branches this, of course, has not been the case, as is evidenced by what has been accomplished in a number of important fields during the past fifteen years.

Of the different branches of botanical science that have been applied to the betterment of man, physiology and pathology stand pre-eminently to the front. We cannot lay any great claim to much in the way of studies in the pure science of physiology, but the practical application of these studies to the affairs of life has been considerable.

In passing, I may be pardoned for emphasizing somewhat in detail a fact that seems to be little appreciated, and that is the great value and usefulness of the individual or organization that can bring to the attention of the people the results of scientific work in such a way that mankind as a whole is bettered, and the struggle for life is made less a burden. What value to the world is a scientific discovery unless it is clothed by some genius with a force that will bring its usefulness home to thousands, where before it would have been known to but a few of the elect? While willing to admit that America, for very good reasons, has not as yet been able to take front rank in the way of original discoveries, no one will deny the fact that our country has quickly turned to practical account discoveries of all kinds where there was promise of practical results. So that while in physiology, laboratory investigations have been pushed with vigor abroad, our efforts have been, in the past, mainly in the direction of broad field work, which has added materially to the wealth and power of the country. This is particularly the case with the work on legumes and the application of laboratory discoveries to the problems connected with nitrogen supply and the rotation of crops. The extended work of Laws and Gilbert, and other experimenters, has done much to emphasize the value of the broad application of laboratory research in this field. It sometimes happens in work of this kind that its application is of such a special nature as to preclude a proper appreciation of its value in a general way. Such, for example, is the work of Löew, who three years ago undertook a very special problem having to do with the handling of tobacco, and which, in two years, was practically finished, but so changed the aspect of the work that it opened great possibilities in building up an important industry and adding wealth to the country as well. The keen competition in tobacco growing, and the fact that the finest grades were, in large part, imported, made it very desirable and important that all available information in regard to the crop be secured. The chief problem upon which light was needed had to do with the fermentation of the leaf. Prior to Löew's work, it was generally held that fermentation was, in large part, due to bacteria, and that the difference in the aromas of tobacco might, to a certain degree, be controlled through the action of these organisms. Löew's work showed that the fermentation of tobacco was due to enzyms. The enzyms causing the fermentation were isolated and methods for controlling them were pointed out. As a result of this work improved methods of handling the crop have been developed and new industries established. Such, for example, is the Sumatra tobacco industry developed in Connecticut, which owes its incentive to the advanced work of Löew, and which bids fair to add a great deal to the material wealth of the country.

Plant breeding is another branch of applied work closely related to physiology, which has made rapid advances during the past few years. It is true that plant breeding leads off into horticulture and other fields, but the advances that have been made in this field in recent years have had their inception largely in botanical studies. The work, as a whole, has had for its object the advancement of industrial pursuits, and has aided materially in adding to the wealth and progress of the country. It is true that in some cases applied work in this line has been pushed in advance of scientific research, but this has led to no serious results, for notwithstanding a lack of knowledge as to the full scientific significance of the various operations performed, the results have in most cases shown far-reaching intuitive knowledge on the part of those who have actually been engaged upon the various problems. What has been accomplished by Bailey, Webber, Waugh, Burbank, Hayes and others has shown great possibilities, and the improvement made in many crops will, no doubt, in time, prove of more value than even the present seems to indicate.

In no branch of botanical science have the advances in applied work been more pronounced than in pathology. Twenty years ago plant pathology was practically unknown in this country. Little or no attempt had been made toward systematic work in this field, and what had been accomplished was largely in the direction of applying information secured as a result of investigations abroad. The first attempts in the study of pathological problems were naturally confined to questions having to do with parasites. The effects of parasitic enemies of plants were pronounced and gave opportunity for the most ready investigation. In looking back, therefore, on the early development of the work, it is not strange to find that investigations, for the most part, were in the direction of economic mycology, for it was largely a study of parasitic fungi in their relation to plant diseases. The important problems connected with the relation of the fungus to the host and host to fungus were, for the most part, overlooked. Pathology, therefore, had its inception largely in mycological investigations, which later developed into a study of the host itself. This naturally led into the field of plant physiology and developed slowly the important work of investigating plant environment and its relation to pathological phenomena. It was early seen that no sharp line of distinction could be drawn between any of these various branches, and for this reason it became important to push the investigations along several different lines. To the early workers in this field is due the credit of laying the foundation which paved the way for a full understanding of the broad problems elucidated later, and as a result the science itself has been established on a firm basis.

It is the practical application of this science, however, that has attracted such widespread attention everywhere, especially the work which has been done in this country and in France. Prior to 1885 very little was known in regard to the treatment of plant diseases. The discovery of the efficacy of certain compounds in the treatment of crop diseases about this time led to a rapid awakening to the importance of the subject, and for the next few years there was a phenomenal advancement in the field treatment of plant maladies. Improvements in laboratory methods also did much to stimulate advanced work, and made possible lines of research which were not practicable before the discovery of such methods. What has been accomplished in this field alone has done much to encourage applied work and show the importance of such work as an aid to the advancement of pure science.

It has become the practice of late to ignore the important part that systematic botany has played in making known the practical value of plants to the human race. In the rage for special problems the fact is often overlooked that many of them owe their inception to prior efforts in taxonomic lines. It is hardly necessary or essential to go into details upon the bearing of systematic botany to applied work; but in passing, attention should be called to the great benefit that has come to the country as a whole through the important work on grasses, forestry and medicine. Some of the earliest work in economic lines in this country was based primarily on the systematic study of grasses, the object being to determine their agricultural value. The early investigations of Vasey did much to call attention to the value of applied botany, and there has been developed from this work very important and far reaching lines of research, such as are now being carried on by the United States Department of Agriculture and many of the experiment stations. This work, while having for its basis systematic studies, extends into broad fields of agronomy and other lines, such as have to do with the improvement of pastures or range lands, and many other similar lines. The same is true of many of the important investigations that have been carried on in the matter of studying noxious plants, as, for example, weeds, etc.

The advanced forestry work of the present also owes its inception, primarily, to systematic studies which were begun years ago, and which are still continued in order to form an intelligent and rational basis for many of the advanced problems in this field.

In medicine, too, the study of systematic botany has played an important part. It was the general practice in the early days for physicians to be trained in botanical lines, and a great deal of our most important information has been brought out by the work of these same physicians. In fact, it has generally been considered necessary for physicians to be pretty thoroughly posted on botanical matters; hence the close relationship of botany to the practice of medicine has always been recognized. With systematic botany as a basis, the study of materia medica has advanced rapidly and has formed an important item in the development of our work. The differentiation of pharmacy from medicine has also led to further advancement in these lines, and has done much to advance the value of the investigations.

Probably in no other field of botanical science has the applied work been of more value to mankind than in bacteriology, surgery and sanitation. The systematic study of the causes of disease has led to most valuable results, and in nearly all of these investigations the inception of the work can be traced to one or more lines of botanical science. Such, in brief, have been some of the advances in applied botany in this country, and with this somewhat hasty sketch in mind, let us turn our attention to the future and consider what opportunities are before us, and along what lines our efforts should be put forth in order to achieve the highest and best results.

Attention has already been called to the importance and necessity of constantly keeping in mind the fact that in the application of science we cannot be too careful as to the foundation of our work. In the race for results we are too apt to lose sight of this fact, and in the end we find, too late, that our entire fabric has been built of straw, and tumbles to earth at the first gust of wind. It is necessary, therefore, in looking to the future development of applied work in this country, that we should turn our attention, not so much to the older men who are already in the field, but to the younger generation, who are still to come up; and the training they are getting, or are to get, in the various institutions of learning throughout the country. It is too true that many of our institutions of learning have been slow to recognize applied science; and even now, with all the demand for applied work, little or no effort is being made to put this work on the basis where it belongs. The training in applied lines at this time is meeting with much the same opposition that science itself did when first introduced into our colleges—especially science as taught by laboratory methods, rather than science as taught by handing down from year to year doubtful knowledge long stored in dusty tomes. There was a time, and not so far distant, either, when to be a student in a science course in some of our institutions required considerable moral stamina; but all this is changed with respect to science; yet there still lingers that inherent hostility to all things practical, as is most strikingly emphasized in institutions where applied work, such as agriculture, engineering, etc., is made a part of the regular course. With the great increase of wealth in this country and the commendable spirit being manifested in the endowment and establishment of institutions of learning, the fact must not be lost sight of that there may be some danger, as has been pointed out, in building up an "educated proletariat," a class who, as specialists, will care more for getting their names attached to abstruse technical brochures than they will for a treatise that will enable some struggling mortal to make life less a burden. Some one has truly said that the danger from education is not so much from its quantity as from its character, so that it is the character of our training that should receive most careful, conscientious and considerate thought.

This leads us now to a consideration of the nature of the training our young men should receive in order to fit them more especially for the opening fields of labor in applied botany, and at the same time make good citizens of them, whether they go into the work in question or some other equally important. Pure

* Vice-presidential address before the Section of Botany, American Association for the Advancement of Science. Pittsburg meeting, June 28 to July 3, 1902.

science, of course, must form the groundwork for this training, but in addition to that there should be parallel with it, throughout the entire course, a rigid system of training in the application of science to the practical affairs of life. It is needless to say that we do not have anywhere in this country, at the present time, such a course of training in botany; and for this reason the men who go into this kind of work must receive their training, in large part, after the college doors close on them. I do not wish to be understood as implying that this state of affairs is due to our teachers, for most of them recognize the fact just mentioned and are doing everything in their power to overcome it. The trouble is with our system of education as a whole, but more directly the body politic, which has, ever since mind training began, given preference to the ornamental rather than the useful. Nothing has done so much to weaken this idea in the human mind as science itself, and nothing can so strengthen science in what it can further do in this direction as to teach its broad practical application to the affairs of life. It would seem, therefore, that the time is ripe for some decided action leading to a clearer understanding as to the methods whereby the increasing demand for men trained in applied botanical work may be met. The National government alone is spending close onto a million dollars a year in this work, and the demand for the right kind of men far exceeds the supply. In fact, the government, through lack of properly trained men, has been forced to undertake the training itself, a course which would not be necessary if the proper co-operation could be secured from the colleges. Here is a subject which might very properly be taken up by this Association, and more especially this Section, as it is one in which most of us are either directly or indirectly interested. I have dwelt upon it somewhat in detail, as it has seemed to me the foundation upon which all other matters are built. With the men that we have and the men we can get, what are some of the problems with which applied botany in the future can hope to deal?

With the opening of new territory during the past few years there has of course developed a need for still broader work, for we are now especially pressed for tropical investigations, which we are unable to meet through lack of equipment and lack of properly trained men. Moreover, another and equally important field has been opened through the rapid extension of our population into the arid and semiarid regions; and the demand from these people for light on many subjects, which we are ill prepared to give. It seems to me that everything points to the fact that the heavy demands for applied botanical work for the next fifty years will be mainly in the field of plant physiology and pathology. The two subjects are intimately connected, and while there will, of course, be many physiological problems pure and simple, somewhere and at some time these problems will be found closely associated with pathological phenomena.

Reverting to our Western conditions, arid and semiarid, there are many questions which demand immediate attention and which have an important bearing on the future development of the country. Such, for example, are those which have to do with the water supply of plants and the bearing of water supply on plant production. Irrigation is now an important factor in our industrial and commercial development, and the problems associated with it must be reckoned with. In the past the work in this field has been mainly of an engineering nature, such as the question of securing water and bringing it as economically as possible to the plants. Now arise far more reaching questions, such as how to handle this water in a way to attain the desired maximum results with the least expenditure of time and money. Given water, soil rich in plant food and proper heat and light, the productive power of plants is great if the requisite knowledge is present as to how best to utilize what nature and art supply. Such problems as these must, for the most part, be worked out in the field, but the field must be made to take the part of a laboratory, for laboratory methods on an extensive scale must be employed.

What is the effect of varying quantities of water on the longevity of a plant; how is the production of fruit and foliage affected by the water supply; how far can time of ripening, color, keeping qualities, and resistance to diseases and insect attacks, be controlled through the ability to control the amount of water used? These problems, on their face, appear simple, but they are important ones and to throw light upon them there must be most careful studies in a number of fields. Chemistry will of course enter into these studies, but it must be a living, vital chemistry, if I may use such a term, and not the mere question of ash determinations. Closely related to the problems involved in water supply are those which have to do with so-called alkali soils, and their effects on vegetation. A question of supreme importance to the development of our western country is to know more of the effects of various mineral salts, severally and combined, on plants. With such complicated problems as present themselves to the investigator in this field, it is not safe to base any conclusions on the knowledge of how plants behave in a laboratory, where the action of a single salt or simple combination of salts has been determined. The fact that individual plants show marked differences in their ability to resist the poisonous effects of alkali salts opens up an interesting field in the matter of plant selection and plant breeding. Wherever crops are grown in alkali soils, especially under irrigation, the power of certain of these plants to make better growth and give greater yields than their nearby neighbors has been noted.

Profiting by these facts, an important field opens in the matter of developing alkali resistant plants, having the power to give relatively large yields in the presence of an unusual amount of soluble salts in the soil. Some interesting suggestions have been made in this direction by the recent work of Kearney and Cameron, and the same investigators have also pointed out the great economic advantages that may result from the combination of two or more salts which, individually, may be dangerous, but when combined have the opposite effect on plant growth.

The nature of the problems here briefly reviewed shows the broad scope of physiological investigations, for they merge at various places into ecology, pathology, chemistry and physics. There is, furthermore, shown the futility of attempting to solve such problems along one line of cleavage, for it cannot be done with any degree of satisfaction.

Aside from the problems mentioned, the field for applied work in plant nutrition is large. The physiological rôle of mineral nutrients in plants is little understood, and the effects of mineral nutrients on growth, singly and combined, should be explained. The power to control profitable plant production through a better knowledge of plant foods is recognized, but there is yet much to do in the matter of making clear little known or obscure questions on this subject. In the problems connected with the acquisition of nitrogen, however, are to be found some of the most important practical questions in this field. The results already accomplished in this direction, through the use of proper nitrifying ferments, have not been as successful as was anticipated, but this does not indicate that future work may not be made more profitable. There is much to be done in the way of investigating the life history of bacteria inhabiting the root tubercles of legumes, for unless such questions are better understood, it will not be practical to apply our knowledge in any far-reaching way. The time will doubtless come, however, when our knowledge of the nitrifying organisms will be sufficient to enable us to apply, in a much broader way, the use of pure cultures of such organisms in general field work. Already encouraging results have been obtained in this direction, and steps are being taken to extend the practical application of these results as rapidly as circumstances will warrant. The future success of this work will no doubt depend, in large measure, upon the ability to properly grow the nitrifying organisms in large quantities and at an expense which will not curtail their use; and then to be able to distribute the organisms in such a way that the farmer himself may use them at little expense, but with sufficient profit to pay for his trouble. It will be seen, therefore, that while these may appear as simple problems when looking at them from the purely utilitarian view, there is much work to be done in the laboratory, under rigid scientific conditions, before satisfactory conclusions can be reached.

It is in connection with the problems bearing on plant breeding, and the selection of plants better adapted to meet the special requirements, that some of the broadest questions of applied botany can be brought to bear. While, as already explained, plant breeding is more or less of a composite science and, to a certain extent, an art, physiology is, after all, the basis for most of the work. There is much need for further research work in the field of reproduction and heredity, especially with a view to obtaining light on many practical questions which are bound to come up within the next few years if applied investigations are to have their proper place. Admitting the necessity of these, it would seem that some of the more practical problems that must be considered within the near future will have to do with obtaining light on such matters as the securing of plants adapted to particular purposes and to particular regions. As population increases and competition in all lines of agricultural production becomes keener, the need for securing plants better adapted to certain conditions and which can be produced at a minimum expense, will become greater and greater. In the South there is already felt the urgent need for improved kinds of cotton varieties that will give greater yields and finer staple, in order that cheap labor of foreign countries can be competed with. There is also a demand for improvement in other plants adapted to the South, which will enable the Southern agriculturist to more generally diversify crops.

We have been told at former meetings of this Association, by members of other Sections, that within a comparatively short time the United States will not be able to grow the amount of wheat, and possibly other cereals, needed for consumption. These statements are based on our present yields and the increasing demands of population. If the figures are true it would seem important, therefore, that attention be drawn to the securing of varieties of wheat better adapted to existing conditions and yielding larger quantities of grain. This is a perfectly legitimate field for applied botanical work, and what has been accomplished already indicates that much can be done in the direction of largely increasing the possibilities of this country in the matter of cereal production. What is true of cotton and cereals is also true of many other crops, so that it is unnecessary to go into detail as to what might be accomplished in the way of causing not only an increased output, but improving the quality of the output as well.

Associated with the work of plant breeding, and more or less closely related to it, is another important field which has for its object the studies of life histories of principal crop plants, with a view of determining the environmental conditions necessary for successful growth. This work, of course, covers a broad field, as it involves knowledge of the requirements of climate and soil, and really merges into the broader territory of ecological work. The problems involved carry with them, not only the question of plant adaptations, but the matter of introducing new plants from foreign countries and the broader dissemination of plants already existing here and which give promise of more profitable yields under changed conditions of environment.

With proper studies of soil and climate, the possibility of more intelligently defining the areas adapted to certain crops will become greater. After all, however, the vital questions involved in this problem will depend largely upon actual experimentation, as those most familiar with successful crop production know how unsafe it is to generalize in such matters. The success or failure in growing a certain crop often depends on differences in soil and climate so slight that present instruments cannot determine them, although the plant, with its power to respond to unmeasurable stimuli, can do so.

In the field of pathology the opportunities for applied work in the near future will be great. We are all agreed that the more or less empirical methods of handling plant diseases has about reached an end. It served a useful purpose in pointing out practical ways of controlling some of the common and destructive plant maladies, and enabled those who were looking to the future to create a sentiment making possible better and more far-reaching work. We do not agree with those, however, who hold that the time is at hand when we can afford to stop the propaganda of actual field treatment. In fact, we are more and more convinced that one of the greatest opportunities for bringing home the practical value of pathological studies will be to undertake at once, on an extensive scale, what may be called demonstration experiments. A propaganda in this field, conducted by and depending upon publications alone, no matter how practical such publications are, will necessarily be slow; but when the work can be carried into the field and be made to serve as an object lesson the impression made is lasting and convincing.

One of the problems, therefore, for the future, in this work, is how to insure the application of the investigations made and to so conduct the work that it will all go toward the development of a system of plant pathology which will build up and strengthen the science. Recognizing the importance and necessity for the application of remedial measures in the form of fungicides, to which the foregoing remarks mainly apply, we may turn our attention from this art, for so it is, to other methods of applied work in this particular field of botany. The future of other lines of applied work all hinges on a recognition of the possibilities within the plant itself, its plasticity and ability to change, the effects of environment and the means of controlling environment or controlling the plant to meet the requirements of environment, to the end of securing desired results. Here again the breeding of plants will enter and furnish the means of overcoming diseases by selection of resistant varieties from those already existing and the creation of new varieties having the desired characteristics. Here, too, arises the question as to what factors govern resistance to disease, and how these factors may be determined and controlled. Why is it that the most successful production of a plant is often reached when its ability to resist the attacks of organisms or to succumb to functional disorders is at a minimum, or, expressing it in a somewhat paradoxical way, why is a plant weakest when it is apparently most vigorous?

Proper knowledge on many of the problems involved in the questions here presented will make it possible to apply it in securing crops at far less risk than at present, and will tend to make the occupation of plant growing less a matter of guesswork than it is now. No rational system of pathology can be developed, futhermore, without due attention to proper field hygiene, the rotation of crops, and other similar means of surrounding the plants with healthful conditions. Some of the principal lines of work, therefore, in the future, in this field, will be in the direction of giving a broader application to existing knowledge on the question of treating plant diseases by means of fungicides, to the development of new forms better able to resist diseases and suitable for special conditions, to the handling of plants so as to better adapt them to conditions at the present, and to the improvement of field methods to the end of securing vigorous growth by furnishing conditions needful to the highest production of the crop.

Of the future problems in other lines of applied botany, it is not necessary to speak in detail. Suffice it to say, that in the broad field of forestry, agrostology and pharmacology, systematic botany will always play an important part. In agrostology, especially, which has now come to be understood as covering the study of not only the true grasses, but all forage crops as well, the field for applied work is exceedingly broad. With the rapid settlement of the East and the utilization of our arable Western lands for crops, the area for the maintenance of stock is becoming less and less. Thus is developed the necessity for a better understanding of methods of improving and maintaining our pastures. The production of larger quantities of forage from given areas and the improvement of our range lands to the end of enabling them to support an increasing number of cattle, are some of the other important problems in this field. These broad questions will, of course, involve to a certain extent systematic studies of native floras, the changes which may result from the shifting of plants from one place to another, and the opportunities that may rise from the introduction of new forms and the improvement of those already present.

Within the last few years it is fortunate that a well-defined forest policy has been developed, so that in the future the growth of this work will be largely in a distinct field. Botanical investigations, however, will always play a more or less important part in all matters pertaining to the subject, especially systematic studies of the tree floras and the application of these studies to questions having to do with reforestation and the protection of existing forest areas. The applied botanical work, in connection with future problems in pharmacology, will be considerable. Systematic studies of plants used in pharmacy, the introduction and cultivation of such plants with a view to increasing their usefulness, all come within this scope of applied botanical research. The study of tropical plants, which has already been referred to, is also bound to play an important part in the near future in the matter of the development of our insular possessions. As yet, we have very little satisfactory information as to the possibilities of tropical agriculture, especially as concerns our own country; and it would seem that some of the first problems will have to do with systematic studies of the field to determine existing possibilities, with a view to applying them in the near future in a practical way. There are numerous practical questions having an important bearing on all tropical work, which must receive attention before any final conclusions can be reached in regard to the successful growing of crops in these regions. These questions have to do with the interrelation of the plants themselves to the development of the existing system of tropical agriculture, so that really a systematic study of our tropical floras would seem one of the first requisites offering a key to the future solution of other and more general problems.

Bacteriology, in its relation to surgery and sanitation, has passed out of the field of applied botany, but problems will still arise. Systematic studies of the bacteria may be essential to the successful prosecution of certain phases of this work. It is hardly necessary to refer to these questions in detail, and I may therefore conclude this somewhat hasty and general sketch of the possibilities of applied botanical work, as we see them, by again calling attention to a fact which becomes more and more evident as we look into work of this nature, and that is, how thoroughly we are all dependent on others for aid, not only in our own field of science, but other fields as well. Like our social fabric, science for science's sake and applied science are becoming more and more a delicately complicated system, capable of endless harmonious expansion if viewed aright, but leading to possible endless discord if handled wrong. How essential, therefore, that the broadest spirit of tolerance should be cultivated, for no matter how small or how humble a piece of real work is, somewhere and some time it may be made to form a part of an harmonious whole. While this is a practical age, and while the demand is heavy for practical results, we should not forget that there are ages to come after us—ages that may demand something different from what the majority of us are producing now; and for this reason the laborer in some obscure field should not be forgotten, for it perhaps may be that his work, now little known or understood, may in the future take its place in the building up of mankind.

B. T. GALLOWAY.

United States Department of Agriculture.

THE INVENTOR OF THE GELATINO-BROMIDE DRY PLATE.

DEATH OF DR. RICHARD LEACH MADDOX.

IT was only three weeks ago that we had to deal with the centenary of the publication of the very first of photographic processes by Thomas Wedgwood. To-day we have to record the decease and review the career of the man who by his publication in 1871 of a method of making gelatino-bromide plates contributed one of the most important stones in the magnificent building reared on Wedgwood's foundation. It is

RICHARD LEACH MADDOX, M.D. (EDIN.)
DIED MAY 11, 1902.

no exaggeration to say that to the gelatino-bromide process as first worked out by Maddox, subsequently elaborated by Kennet, Burgess and Bennett, are due all those wonderful developments of modern photography which the newspapers are never tired of recording, and not only those wonders, but the fact that it is practised by hundreds of amateur workers all over the world, who find in it not business, but healthy recreation and amusement.

It was on August 4, 1816, that Richard Leach Maddox was born at Bath, and it was on Sunday, May 11, 1902, that he died at his residence, No. 45 Belmont Road, Portswood, Southampton. Of his early years and education there is little to record. He selected as his profession the art of healing, and studied and duly qualified for its practice at University College, London, although he subsequently took the degree of Doctor of Medicine at Edinburgh. As in the case of Thomas Wedgwood, ill-health appears to have dogged the steps of Dr. Maddox almost from childhood. In a biography of him, written quite fifteen years ago, we read that he had been a sufferer for fifty years, and advancing age, as might have been expected, did not mend matters. Very early in life he took a voyage round the world for his health, before finally settling at Constantinople, where he practised for some years. It was somewhere about this time that Dr. Maddox did his first photographic work, for in a contribution to Photography (February 11, 1892, page 90) he says: "My first lens was bought abroad about 1846; active professional duties hindered it from being used before 1852. From that date onward as an amateur I have been interested in photography."

From the Bosphorus he went to Smyrna, and the Crimean War found him busily engaged as a civil surgeon in one of the hospitals at Scutari. After a year spent in this work his health compelled him to return to England, where he settled down in practice at Woolston, near Southampton.

He had already married while in Constantinople—in 1849, to be precise—his first wife (Amelia, daughter of Benjamin Winn Ford, Esq.), by whom he has two surviving children—Richard Willes Maddox, an artist, and a daughter (now Mrs. Andrew Gillies).

It is of this Woolston period, which lasted until 1874, that we must attribute the working out of the gelatino-bromide process.

The illustrations which we publish (which are from the first negatives to be made on gelatino-bromide, and are here reproduced for the first time) were taken in 1871, and represent subjects near Woolston. They were shown at the Inventions Exhibition, where they secured a gold medal. In their production Dr. Maddox had the assistance of his daughter (now Mrs. Gillies), so that there can be no doubt of the facts in this connection.

A little more than a year ago, when recording the award of the progress medal of the Royal Photographic Society to Dr. Maddox, we were favored with a sketch from his pen of his scientific work, both in connection with photomicrography and with the gelatine process. Perhaps this would be the best place to quote what he then wrote us.

Photomicrography and bacteriology especially had been the subjects which first aroused his scientific interest, and it was out of photomicrography that his emulsion experiments grew. He had endeavored to extend the use of photography to micrography, and to enlist others to work in the same direction, but he met with most disheartening remarks from those from whom he had hoped for encouragement. They pointed out its inability when compared with the pencil of the draughtsman, especially of such as the late Mr. Tuffin West.

"Still," says Dr. Maddox, "I felt and trusted its day would come, and be of much assistance to the busy microscopist. Thus I continued to work at it with such means as were at hand, the earliest public recognition being the award of a medal in 1853 by the then Photographic Society of London, and by a medal from the council of the International Exhibition of Dublin in 1865, for the series of photomicrographs, published at the time by the late James Howe. From him I purchased Dubosc's micro-solar projection apparatus of the exhibition, I think, of 1867. This was used very largely in my work, I having for the purpose converted a small room which faced the sun into a photomicrographic camera.

"In 1864 I was most generously assisted by my esteemed friend Dr. Lionel Beale, F.R.S., who published a frontispiece of my photomicrographs in his valuable treatise, 'How to Work with the Microscope.' This was, I believe, the first attempt in this country to utilize photomicrography in a book form, though previous illustrations had been given in journals. The late Dr. Donne, whose lectures I had attended, had also published in Paris some most delicate prints obtained through the aid of photography.

"Up to the decease of the late Dr. Woodward, of the Surgeon-General's Office, Washington, D. C., U. S. A., I received much encouragement in my work, through a most friendly correspondence, and I may say the same also from my kind friend Mr. W. H. Wenham, whose contributions to the microscope are of world-wide fame. From the late Mr. George Shadbolt I received every help, while from the late Mr. Mayall (père) I learnt much about making my own collodion and sensitizing paper, both for negatives and prints, for we were then in the flourishing days of collodion.

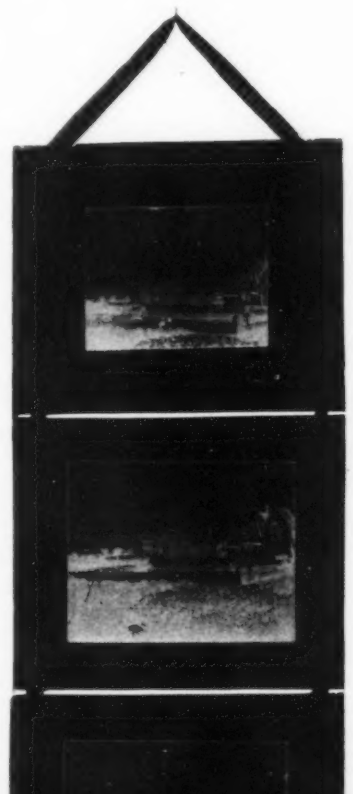
"Somewhere at this period I made some experiments to utilize paper paraffined and sensitized at the same time for obtaining negatives, and sent the results to Mr. Shadbolt; but I was too occupied to follow up the efforts. Microscopic work for friends was constantly coming to hand, and in 1867 I had some very nasty work to do for my late friend Dr. Ed. Parkes, by making drawings of the various organisms found in the fœtid slime on the top and sides of some of the sewers in the borough of Liverpool. These I could not photograph direct, so photographed the drawings which were published in the report of Drs. Ed. Parkes and Burdon Sanderson by order of the council.

"From working so much in a small camera room, I used to get saturated with ether vapor, which was affecting my health, and made me determine to try and find a substitute for wet collodion, which was constantly in request. I am sure it is not necessary to weary you, or your numerous readers, with more details of what led up to my answering the late Mr. Greenwood's earnest request that I would at once furnish him with an article for his journal, as friend Traill-Taylor, the editor, was seriously ill. To try and meet the urgency I sent off a very hurried description of the experiments I had been making with isinglass, gelatine, etc., as a substitute for the collodion. The hurried article was held over for the following week's issue, as Mr. Greenwood replied that other parties had come to the rescue, and he considered the subject a very important one.

"I did not publish more, but continued experimenting. Some of the results—found by my friend the late W. B. Bolton on the mantelpiece of the editor's office among a lot of dirty waste negatives and glass—formed the record of the earliest gelatino-bromide dry plates." (Photography, January 24, 1901, page 56.) These are the negatives we reproduce on this page.

This is not the time to go into the acrimonious discussions that have raged around Dr. Maddox's name. It is sufficient to observe that on his part throughout there was a conspicuous absence of assertiveness and virulence—in fact, beyond a gentle quotation of the statements he published at the time, Dr. Maddox seems to have troubled very little about the dispute. There is no doubt that we have in the deceased gentleman a very high type of the investigator who works for the love of his subject and for truth's sake, with no thought of pecuniary reward and without any attempt to surround his process by the secrecy and legal restrictions which were adopted by some of his successors. In saying this we do so merely to emphasize what has always seemed to be one of the strongest notes in the career of Dr. Maddox, and not with a view of depreciating the labors of his successors, who, if they were so disposed, had, of course, a perfect right to endeavor to secure to themselves the monetary results of their ability.

That the claims of Dr. Maddox were well founded could be shown in many ways. We have not space here to go into the pros and cons at any length, but the matter will perhaps be more satisfactory if we quote the report of the sub-committee of the Committee of Sciences and Arts, constituted for the purpose by the Franklin Institute of the State of Pennsylvania, when it was proposed to award to Dr. Maddox the Scott Legacy medal and premium. The committee report that they "have carefully considered the subject and examined into the merits of the invention claimed by Dr. Maddox. They find that although gelatine had been employed photographically in a variety of ways, and although silver haloid salts had been emulsified successfully with collodion in photographic practice prior to the publication by Dr. Maddox of his gelatino-bromide process, nevertheless the successful emulsification by him of silver haloids with gelatine, and the perfecting of a working process founded upon it, involved so much painstaking experimentation and investigation, and was such a departure from old methods, that it merits recognition on account of its marked influence on the progress of photography, on the enlargement of its practice, and the multiplication of its applications in technical and purely scientific directions. The process, though affording negatives of good quality, was soon improved in regard to the quality and sensitiveness of the plates by different individuals, by the removal of the soluble salts, by heating to higher temperatures, by prolonged digestion, by the addition of ammonia, and by changes in minor details. In consideration, therefore, of the novelty of the process, and its value, and of the publication of it without any reservation of rights, your committee recommend the award of the Scott Legacy medal and premium to Dr. Richard Leach Maddox



EXHIBITED AT THE INVENTIONS EXHIBITION, 1885, AND AWARDED A GOLD MEDAL.

for the substitution of gelatine for collodion in photography as accomplished by him." It will perhaps suffice if we point out that the committee was an exceptionally strong one, containing, among others, Mr. John Carbutt and Mr. F. E. Ives.

Dr. Maddox's first wife died in 1871, and in 1874 he left Woolston to become resident medical man to His Grace the Duke of Montrose. From this engagement he went in a similar capacity to Sir Williams Watkin Wynn.

On the 25th of October, 1875, he married Agnes, a daughter of George Sharp, Esq., who survives him, and by whom he had one son, Walter Vaughan Maddox, who is now in business at Cardiff. Immediately after his second marriage Dr. Maddox went abroad, where he spent much time practising as the English physician for several seasons at different health resorts—among others, Ajacmio, Bordighera and Cornegliano, returning to England finally in 1879, and settling at Gunnersbury, whence he removed in 1886 to occupy the house in Southampton where he breathed his last.

Recognition of his work came to Dr. Maddox late in life. In the middle of 1889 he was awarded the Scott medal of the Franklin Institute already referred to, and in 1892 a small committee was formed, with Mr. Andrew Pringle as honorary secretary, in order to present to the veteran discoverer a testimonial for the services rendered to photography. It having been reported that through a defaulting trustee Dr. Maddox had lost heavily, the committee, upon which, among others, Sir William Abney, Mr. George

Davison and Mr. Henry Sturney sat, collected a sum in excess of £400, which was handed to Dr. Maddox "in recognition of his services to photography, and especially of his investigations in connection with gelatine emulsion." The Britannia Works Company headed the list with the munificent gift of £100, and among the other subscribers were many of the plate manufacturers both in England and abroad, the foreign contributors including Mr. Carbutt and Dr. Van Monckhoven.

He had already received the gold medal of the Inventions Exhibition of 1885, at which he exhibited the earliest specimens of gelatino-bromide negatives, made in 1871. At the beginning of last year he was awarded the Progress medal of the Royal Photographic Society for his early work with gelatino-bromide.

Dr. Maddox preserved his interest and energy in scientific matters till the last; almost within a day of his decease he wrote a letter to the papers upon the subject of the Holy Shroud at Turin. On Saturday, May 10, he was suddenly taken much worse with his old-standing complaint, aneurism of the aorta, and the next day, after great suffering, he breathed his last, the immediate cause of death being syncope. He was buried on Thursday, May 15, at the Cemetery, Southampton, England.—Photography.

ETCHING GLASS BY MEANS OF GLUE.

CERTAIN substances adhere to glass with such tenacity that, upon being abruptly separated therefrom, vitreous scales are often detached. This fact, says Prof. Cailletet, in La Nature, I noticed a long time ago while studying a process that should permit me to solder glass to metals. The method of soldering then discovered I now employ for adapting cocks or other metallic fittings to tubes designed to conduct gases under high pressures. In order to solder a piece of metal to a glass tube it suffices, in fact, to silver the latter in order to render it a conductor of electricity, and then to deposit upon the silvered portion a ring of galvanic copper, to which any metal whatever may be soldered with tin. The galvanic copper thus deposited adheres so tenaciously to the glass that, upon being detached, flakes of glass are removed at the same time.

Silicate of soda, which is often used for uniting two pieces of glass, exhibits the same phenomena; but the detaching of the surface of glass objects becomes particularly easy when we employ either common glue or isinglass.

It is only necessary to cover a piece of ordinary or flint glass with a coat of glue dissolved in water in order to see that the layer of glue, upon contracting through the effect of desiccation, becomes detached from the glass and removes therefrom numerous scales of varying thickness. The glass thus etched presents a sort of regular and decorative design that reminds us of the flowers of frost deposited upon our window panes in winter. When salts that are readily crystallizable and that exert no chemical action upon the gelatine are dissolved in the latter the figures etched upon the glass exhibit a crystalline appearance that recalls fern fronds.

Hyposulphite of soda and chlorate and nitrate of potash produce pretty nearly the same effects. A large number of mineral substances are attacked by gelatine. What is called "toughened" glass is easily etched, and the same is the case with fluorspar and polished marble. A piece of rock crystal, cut at right angles with the axis and coated with isinglass, the action of which seems to be particularly energetic, is likewise attacked at different points, and the parts detached present a conchoidal appearance. The contraction of the gelatine may be rendered visible by applying a coating of glue to plane sheets of cardboard or lead, which bend backward in drying and assume the form of an irregular cylinder.

Such etching of glass and different mineral substances by the action of gelatine may be employed for the decoration of numerous objects.

Should any of our readers be desirous of trying this process of decoration he may obtain perfect success by conforming to the following very simple directions: Dissolve some common glue in ordinary water heated by a water-bath and add thereto six per cent of its weight of potash alum. After the glue has become perfectly melted, homogeneous and of the consistency of sirup, apply a layer, while it is still hot, to a glass object by means of a brush. If the object is of ground glass the action of the glue will be still more energetic. About half an hour afterward apply a second coat in such a way as to obtain a smooth, transparent surface destitute of air bubbles. Now leave the object to itself, and after the glue has become so hard that it no longer yields to the pressure of the fingernail (say, in about twenty-four hours), put the article in a warmer place, say, for example, in a kitchen range, in which the temperature must not exceed 105 deg. F. When the object is removed from the oven, after a few hours' stay therein, the glue will detach itself with a noise and removes with it numerous flakes of glass. All that the piece then requires is to be carefully washed and dried.

The designs thus obtained are not always the same, the thickness of the coat of glue, the time of desiccation and various other conditions seeming to act in such a way as to modify the form and number of the flakes detached.

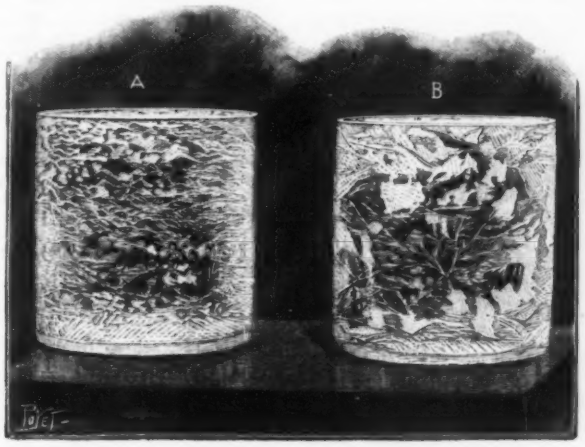


FIG. 1.—A. GLASS VESSEL ETCHED BY THE ACTION OF GLUE AND ALUM. B. VESSEL ETCHED BY PURE GLUE.

It is indispensable to employ glass objects of adequate thickness, since, in covering what is called "muslin" glass with a layer of glue, the mechanical action that it has to support during desiccation is so powerful that it will break with an explosion. Glue, therefore, must not be allowed to dry in glass vessels, since they would be corroded and broken thereby in a very short time.

JAPAN'S MERCANTILE MARINE.

M. DUBAIL, the French Minister to Japan, publishes some interesting details in the Bulletin Economique of Indo-China concerning the Japanese mercantile marine. The statistics referred to are taken from a report issued by the Japanese Minister of Communications, and they deal with the steady increase in the number of steamers and sailing vessels in the Japanese merchant service during the last four years:

	Steamers.	Tonnage.	Sailing Ships.	Tonnage.
January,	1898.....627	420,774	174	24,014
January,	1899.....679	470,534	1,495	165,710
January,	1900.....758	498,375	2,783	270,161
September 16,	1901.....942	557,166	3,416	315,576

Thus it will be seen that the Japanese mercantile marine has increased in three and a half years by 315 steamers, and by 3242 sailing vessels, the increase in tonnage in each class being respectively 127,392 and 294,562 tons. This is a striking rate of progress, and one rarely met with in the case of other countries, especially if the increase in the number of large steamers is taken into account. In fact, in 1896 Japan possessed only one merchant steamer of a tonnage exceeding 5000 tons; but at this moment it possesses twenty-one steamers whose individual tonnage is above 5000 tons. In proportion as the volume of shipping has grown so there has been an increase in the number of seamen available for manning the ships, and it is to be remarked that Japan can provide its own skippers and naval engineers. At the end of last June the number of ship's officers with a captain's certificate, and of engineers, was 15,412, of whom 15,108 were Japanese and only 304 were foreigners. The number of engineers serving in the mercantile marine of Japan was 2791.

SOME FACTS ABOUT THE PANAMA HAT.

WITH Panama hats in such unprecedented demand as they are this season, it is not surprising that much has been written concerning them.

According to Men's Wear the plant from which is obtained the material of which the hats are made is commonly called the Panama hat palm, although botanists do not group it under the head of palms, classifying it under the name Cyclanthaceæ. The botanical name of the particular species with which we are concerned is Carludovica palmata. The South American natives call it Palma de Pina. It is indigenous to parts of Ecuador, Colombia, Peru, Brazil and Central America.

Right here it may be well to define certain terms that have been used by writers in connection with this subject, and which have appeared in advertisements in the daily papers, without their meaning being clear.

The word Jipijapa is really the name of an interior town in Ecuador, and the natives in that part of the country commonly speak of the Panama hat as the Jipijapa hat. Another word that has been frequently used is Manabi. This is the name of a province in Ecuador, and Manabi hat is also synonymous with Panama hat. In Manabi province is the city of Monte Cristi, where some exceedingly fine hats come from.

The expression paja toquilla has been erroneously used by some writers as being the name of the plant, but it is the name of the straw obtained from the plant, as anyone who knows Spanish might readily have understood, since the word paja means straw.

Many will be surprised to know that this straw is made from the flat leaf, and not from the stalk of the plant, for a casual glance at the exterior surface of a Panama hat would give the impression that the hat was woven from a fiber of cylindrical form. However, close scrutiny of the inner surface of the hat will disclose the fact that the fiber is not a cylinder.

The method of preparing the straw is as follows: Young plants, not over four or five feet in height, are used for this purpose. Only the leaves that are young, stiff and in prime condition can be used. These are split into narrow strips by the native, who for this purpose uses his finger nails. But the strips are not separated at the stalk end. These bunches are then bleached in the sun. Up to this point you still have the flat straw; but what we shall call the rounding, for want of a better name, is accomplished by the deft-fingered native, aided by the natural tendency of the strip to curl. The strip is rolled from each of its two edges toward its middle, and thus is formed, ready for plaiting into a hat body, that excellent straw with no raw edges and which is deceptively like a cylinder.

The French Panamas are made of this same material, which is exported to Nancy, Saar Union and other places in Europe, where the French Panama hats are made.

The statements that Panama hats are woven under water, or that the very fine ones are woven only by candlelight, are characterized as incorrect by a man who has all his life been engaged as a first hand in the Panama hat trade, and who has not only seen the hats made, but has made Panama hats himself.

It is true that the hats are woven in the early morning hours when the atmosphere is damp, as the heat of the sun makes the fiber brittle and unfit for manipulation. At night the hat is hung out in the open air, where it absorbs the dew, and is the next day again in condition to be worked. This accounts for the great length of time required in the hat making, one of the very fine grades requiring upward of three and a half months to produce.

The hat is woven on a block which is held between the knees of the operator, although some of the very coarse hats are woven on the knee of the native too poor to own a hat block. Men, women and children among the native Indians are engaged in the weaving of the hats. To the children is intrusted only the making of the coarser grades, and the youngsters become more skillful from year to year, and in time some of them become experts, capable of making the exceedingly fine hats. Those who have long been engaged in the handling of Panama hats know from a glance at the button from what locality the hat comes. The button is the little central portion of the crown of the hat, at which point the weaving begins and extends outward toward the edge.

While a great deal has been written about $100 and $250 hats, it must be remembered that these are few in number. When one takes into consideration that a broken straw or a straw not matching in color the rest of the hat, or a knot showing makes the hat defective, it will be realized that there cannot be many of these extremely fine hats produced. The finishing of the hat is an operation requiring much skill, because each of

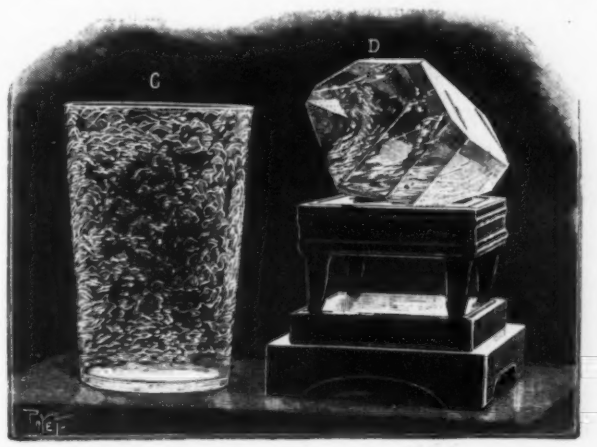


FIG. 2.—C. TOUGHENED-GLASS VESSEL ETCHED BY GLUE AND HYPOSULPHITE OF SODA. D. ROCK CRYSTAL ETCHED BY THE ACTION OF ISINGLASS.

the overlapping fibers has to be nicely turned back into the edge of the crown and trimmed off.

Of course, most people in the trade are by this time aware that the Panama hats are not made in Panama at all. The great majority of the hats made in Peru and Ecuador find their way to Guayaquil, whence they are shipped to Panama, and, crossing the isthmus, are shipped from Colon. This is not true of the hats made in Colombia, many of which are shipped from Cartagena or Savanilla.

The great market and distributing point for Panama hats in Havana, and it is an interesting and curious fact that most of the Panama hats sold in New York go from South America to Havana, via the United States in transit. This is because of the fact that the steamers do not deviate from their regular routes. Recently, however, some shipments of hats have been landed in the United States without going to Havana and then back again.

SOME OF THE MORE IMPORTANT SCIENTIFIC PAPERS READ AT THE PITTSBURG MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

By MARCUS BENJAMIN, Ph.D.

THE scientific work of the American Association consists usually in the presentation of papers before the Sections of that Association, descriptive of investigations carried on in the laboratory or in the field during the year. There are ten different Sections, each one of which is devoted to some special branch or branches of science, and over each there is a vice-president as chairman.

The first of these Sections is devoted to Mathematics and Astronomy, and twenty-four papers were assigned to it, nearly all of which were of a highly technical character. One of these was by Prof. George W. Hough, of the Northwestern University, N. Y., on "The Definite Determination of the Causes of Variation in Level and Azimuth of Large Meridian Instruments." The author showed that the old theory with regard to changes affecting level errors in large meridian instruments was due to a misconception of the phenomena observed. The theory was founded on observations made at Edinburgh, where the instrument was mounted on a hill of red sandstone which was affected by temperature. Subsequently, astronomers applied the same theory to instruments mounted on clay or sand and gravel. In the first case the instrument was mounted on the top of stone, and in the second case the instrument was placed six feet below the surface, hence the effect of temperature would be of fact that difference in the two cases. The phenomenon observed at Edinburgh was due simply to the lag in warming up stone piers on which the instrument was mounted. It is interesting to add that President Asaph Hall delivered before this Section some of his recent observations concerning "The Mass of the Rings of Saturn." Also Prof. G. B. Halsted, Vice-President-elect of the Section, presented a paper on "A New Founding of Spherics."

Section B is devoted to Physics, and the titles of forty-five papers were presented before it, together with some fourteen others that were read at a joint session with the American Physical Society. Among these papers may be mentioned one by Prof. Henry S. Carhart, of the University of Michigan, entitled "Contributions to the Theory of Concentration Cells," in which he brought forward some experiments that point very strongly toward a new theory of electrical cells. Prof. J. S. Shearer, of Cornell University, under the title of "Coefficients of Expansion between 0 deg. and 190 deg. C.," described a series of experiments which show the expansion coefficients between the temperature of melting ice and that of liquid air, which were undertaken so that a chemical apparatus for low temperature work might be properly designed. Prof. G. S. Moler, under the title "A Set of Direct-Current Dynamos Arranged in Series for High-Tension Work," described a very interesting plant in which a potential of 12,000 volts is obtained by running twenty-four dynamos of 500 volts each in series. Profs. W. Ambler and Frank Allen, also of Cornell University, presented a paper entitled "Test of Liquid Air Machine." They found, after a careful set of experiments on a liquid air machine, that 116 grammes of this substance can be made by one horse power in one hour, and that only about two per cent of all the energy expended is stored up in the liquid. Nichols and Hull have revised their determination of the pressure exerted by light, and find that it varies only four per cent from that deduced from theory. Dr. Allen presented some results of important bearing upon the theory of how we see colors, with lantern illustrations, under the title of "Some Experiments on Retinal Fatigue and Persistence of Vision." Prof. H. T. Eddy, of the University of Minnesota, described "The Just Intonation Pianoforte of Dr. S. A. Hageman," an instrument in which by means of stops worked by pedals the key could easily be changed. This paper was criticised, on the ground that the instrument was impracticable from a musical standpoint, as no piano would remain in perfect tune long enough to make Dr. Hageman's invention of practical benefit. It was also before this Section that Past-President Edward W. Morley gave the results of his latest experiments on the "Tension of Mercury Vapor at Ordinary Temperatures."

The next Section is that devoted to Chemistry, and its members met in affiliation with the American Chemical Society. As this is one of the largest Sections in the Association, there were twenty-nine papers read before the Section, together with sixty-nine papers that were presented by members of the American Chemical Society. They were for the most part highly technical, especially those on Organic Chemistry, which included such titles as "Symmetrical Trimethylbenzyl, Symmetrical Trimethylbenzene Hydrazone and Some of its Derivatives," by Everhart P. Harding, and "The Action of Valerianic Acid and Valeric Aldehyde upon Antipyrin," by David C. Eccles. One paper, however, that attracted some attention was on "A New Glass of Low Solubility," by G. E. Barton. It is generally supposed that glass is unattacked by any ordinary liquid, but the author showed that all glass is dissolved by acids and most other chemicals, and that even water affects it to a considerable extent. He also described a method for determining the amount of the action upon the glass, and gave figures for the weights dissolved, which were correct within the weight of a hair. This glass is said to cost very little more than other kinds, and will without doubt be almost exclusively used for scientific apparatus and many other purposes where the property of resisting moisture is important.

The generous hospitality of the manufacturing plants in the vicinity of Pittsburg, in throwing open their works to the chemists, was highly appreciated. Chemistry has played a large part in the improvement in the manufacture of metals, and because of the lack of a thorough knowledge of chemistry on the part of engineers their work is as defective as ten years ago. With the aid of the chemists it gives the manufacturer perfect control of the metal.

Those interested in Mechanical Science and Engineering met with Section D. There were only twenty-three papers read before this Section, and among these was one on "The Nomenclature of Mechanics," by Past-President R. S. Woodward, of the Columbia University. Also "The Rules and Regulations Concerning Airship Contests at the Louisiana Purchase Fair," was the title of a short paper by Prof. C. M. Woodward, of the Washington University of St. Louis. At the special request of the members of this Section, Capt. Sibert, of the United States Engineers' office in Pittsburg, gave an informal address in the lecture hall at the Carnegie Institute on "Bridges and Other Structures in the Philippines." He was chief engineer with the Eighth Army Corps during the Philippine campaign, and his interesting address, illustrated with lantern slides, was devoted to the works constructed by the army engineers in the field.

Section E is devoted to the subjects of Geology and Geography. Some twenty-six papers were presented before this Section, which met part of the time with the Geological Society of America. A paper descriptive of "The Discovery of a Musk-Ox Skull in the Glacial Terrace near Steubenville, O.," was read by Samuel Huston, of Pittsburg, and proved very interesting as a discussion as to the probability of the musk ox roaming as far south as Steubenville in years past. It was also before this Section that Gilbert H. Grovenor made his plea for "The International Geographic Congress of 1904, under the Auspices of the National Geographic Society." The "Great Canyon of the Euphrates River" was the title of an interesting paper by Ellsworth Huntington, who told how in 1838 the great German general, Von Moltke, floated down this part of the stream on a raft of inflated sheepskins, manned by Kurds, but the rapids were so formidable that for over sixty years no other Europeans visited the region. In the spring of 1901, with Prof. T. H. Norton, United States consul at Harput, Turkey, the author made the same journey, using a raft of inflated sheepskins, manned by American fishermen. Two small canyons were traversed, the second of which, nearly 2000 feet deep, was the picturesque home of large herds of ibex. Below this is a holy mountain, with several shrines, at one of which rises an immense square altar of rough stone all covered with the gore of the goats and sheep which are here offered in sacrifice by both Christian Armenians and Mohammedan Turks. The main canyon is cleft through the mountains to a depth of from 3000 to 5000 feet, and the contracted stream thundered over rapid after rapid between towering walls of frowning basalt or castellated buff limestone. During the final session of this Section a series of papers dealing with the recent volcanic eruption in the West Indies were presented by R. T. Hill, I. C. Russell, and Angelo Heilprin, under the auspices of the National Geographic Society, which then met in conjunction with the Section.

Zoology is the special topic to which Section F is devoted, and before it there were presented fourteen papers. Among these was an illustrated description of "The Blind Fishes of Cuba," by Prof. Carl H. Eigenmann, of the University of Indiana, who is accepted as the foremost authority on that subject in this country. Also of considerable interest was a paper on "The Habits of Fresh-water Lampreys," by Harvey A. Surface, of the Pennsylvania State College. This paper was illustrated by lantern slides, by means of which the author explained how these denizens of fresh water prey upon the fishes. The fact that many food fish are without any skin when taken, he said, is due to their having been attacked by lampreys. Two papers, likewise illustrated, were presented before this Section, the first on "The Problem of Getting Air, and How It is Solved by Aquatic Insects," by Prof. James G. Needham, of Lake Forest College, and the second, "Insect Enemies: A Matter of Taste," by Prof. Francis M. Webster, of Wooster, Ohio.

Section G, in conjunction with the Botanical Club of the Association and the Botanical Society of America, took up papers devoted to Botany. There were twenty-six papers presented before the Section and an equal number before the Club, as well as twenty-eight that were read in joint session of the Section with the Botanical Society. It was before the Botanical Society that President Byron D. Halsted delivered his address entitled "Two Centuries of American Botany." It discussed the rudimentary state of botany years ago, and its gradual growth into the science it is to-day. It is interesting to add that by special vote of the Botanical Society, an annual grant of $500 has been made for the advance of botanical research.

By far the most popular of all the Sections is H, which is devoted to Anthropology. About thirty papers were read before this Section, and most of its sessions were held in connection with the American Anthropological Association and the American Folk-lore Society. The sessions began with a discussion relative to the affiliation of the American Anthropological Association with the Section. At the second session, the papers were for the most part devoted to the relations of Anthropological Museums and Schools. Perhaps the paper that attracted the most attention was the one on "Climatic Changes in Central Asia, Traced to Their Probable Cause, and Discussed with Reference to Their Bearing upon the Early Migrations of Mankind," by Prof. G. Frederick Wright, who in discussing his visit to Asia said: "I started with the theory that these climatic changes were probably connected with glacial phenomena throughout that region corresponding to those in North America and in Europe. But, upon not finding the evidences of any extensive glacial occupation anywhere in Central or Western Asia, I turned with more favor to the natural explanation offered by the theory of an extensive subsidence of the Asiatic continent, approximately contemporaneous with the accumulation of ice during the glacial period over North America and Europe." With reference to the cradle of the human race, always a favorite topic for speculation among scientific men, he said: "But it is the relation of these changing climatic conditions to the early history of mankind which is immediately before our minds on the present occasion. There are numerous indications that Turkestan has been one of the most important centers, if not the original center, from which the human race has radiated. Here the conditions of life are still extremely favorable, and in the earlier climatic conditions were even more favorable than now." "The Late Dr. Thomas Wilson," a past presiding officer of the Section, was the subject of a sketch by Warren K. Moorhead, who described the characteristics of the distinguished archæologist who was the late curator of the department of anthropology at the Smithsonian Institution. Dr. Wilson made numerous researches in France and the United States and published many reports and papers. He was of a peculiarly pleasing personality, and was particularly kind to young men who desired to make anthropology a lifework.

Section I is devoted to social and economic science, and although one of the smaller sections, it developed considerable activity at the present meeting. The titles of twenty-two papers were presented before this section. The industrial interests of Pittsburg were elaborately presented in three papers, as follows: "The Economic Situation of Pittsburg," by George H. Anderson; "The Electrical Industries of Pittsburg and Their Economic Influence," by G. H. Gibson, and "The Genesis of Pittsburg as a Seat of Iron Manufacture," by J. B. Johnston. The subject of trusts was discussed in several papers, notably one by H. T. Newcomb, who contended that "the tendencies of the great corporations are toward the payment of better wages, toward greater stability of employment and toward the general amelioration of the conditions of labor. These things make for the diffusion of wealth, but not so strongly as the presence of a powerful incentive to saving, combined with recognized opportunities for investments, from which satisfactory and stable returns may be anticipated. Savings banks, insurance companies, building and loan associations, societies for mutual relief and many other financial institutions which have attained high development in this country have tended strongly to secure three desirable ends. They have aided in the accumulation, increased the productive utilization and fostered the diffusion of wealth; but I submit that they are now supplemented and, in the course of progress already foreshadowed, will be still more powerfully reinforced by a greater force—that of the industrial combination and its legal adjunct, the business corporation." The Hon. Simeon E. Baldwin, of New Haven, under the title, "The Change of Position, During the Nineteenth Century, of the Business Corporation," said the "trust" at first was an abandonment of the corporate idea for that of partnership. Now it is reverting to the corporate type. The mobility of most business corporations is greater than that of a natural person, for they can choose their birthplace, and incorporate where they find incorporation offered on the easiest terms. They can also reincorporate subsequently in some other State and so die and revive again. Perhaps we have made free incorporations too easy. The end of the century saw our States bidding against each other to attract capital for this purpose. It brought a financial panic upon Germany in 1901. Stocks and bonds on the Berlin Exchange fell in price to the aggregate amount of $500,000,000. One trouble was that they had formed corporations to promote other corporations, and virtually to own them. We have fallen in the same way. The Hon. Carroll D. Wright, who was the presiding officer of the Section, spoke on "The Necessity of Co-operation Between the Federal Census Office and State Statistical Offices." He emphasized the need of co-operation between the Federal Census Bureau and State bureaus, especially since a permanent Census Bureau has been established by Congress. He pointed out that the remarkable growth of American industries and our internal development make more imperative this need, and also resulting accurate statistics for the information of the public and those engaged in business and manufacture. In thirty-eight States and Territories offices of a statistical character exist, and twenty-seven States have constitutional provisions on the subject.

It was originally intended that Section K, which is devoted to Physiology and Experimental Medicine, should be organized at this meeting, but for important reasons that were discussed in the Council, it was found desirable to postpone such action until the mid-winter meeting, and, therefore, no papers were presented before it.

LINERS AS ARMED CRUISERS.

IN view of the great interest which is being taken in the question of subsidizing our steamers, the details in regard to the merchant liners now under contract with his Majesty's government for use as armed cruisers in time of war are of more than ordinary importance, says The Shipping World. The return was issued as a Parliamentary paper on June 25, and is given below in full. That the amount allocated for the purpose does not err on the side of liberality will be seen from the figures given. From these it will be observed that the White Sar Line have to hold eight of their magnificent ships, aggregating 79,705 tons, at the disposal of the Admiralty until Aprfl 1, 1905, for a pittance of £28,000 per annum, or, say, seven shillings per ton per annum, off which 25 per cent is deducted in the case of each ship which is in receipt of payment for carrying mails. Similarly the Cunard Company holds seven of its splendid vessels, aggregating 77,182 tons, at the beck and call of the country for the miserable bonus of £28,000

per annum. We may certainly thank the patriotism of our shipowners, rather than the payments of the Admiralty, for having so many fine merchant liners under contract with the government for use as armed cruisers in time of war, as is set out in the return which we print below:

Name of Vessel.	When Built.	Tonnage (Gross).	Amount of Annual Subsidy.*	Date of Expiry of Contract.
White Star Line.				
Oceanic	1899	17,274	£10,000	April 1, 1905
Majestic	1889	9,965	9,000	"
Teutonic	1889	9,984	9,000	"
Britannic	1874	5,004	Nil	"
Germanic	1874	5,071	"	"
Gothic	1893	7,755	"	"
Cymric	1898	12,647	"	"
Medic	1898	11,985	"	"
Cunard Company.				
Campania	1893	12,950	10,000	April 1, 1905
Lucania	1893	12,952	10,000	"
Umbria	1884	8,128	8,000	"
Etruria	1884	8,120	Nil	"
Aurania	1883	7,269	"	"
Ivernia	1900	13,800	"	"
Saxonia	1900	13,963	"	"
Peninsular and Oriental Steam Navigation Company.				
Caledonia	1894	7,558	4,500	April 1, 1905
Persia	1900	7,931	4,500	"
Arabia	1893	7,903	4,500	"
India	1896	7,911	4,500	"
China	1896	7,912	Nil	"
Egypt	1897	7,912	"	"
Himalaya	1892	6,898	"	"
Australia	1892	6,901	"	"
Victoria	1887	6,527	"	"
Britannia	1887	6,525	"	"
Arcadia	1888	6,603	"	"
Oceana	1888	6,603	"	"
Orient.				
Omrah	1899	8,291	4,500	Oct. 1, 1905
Ophir	1891	6,190	4,500	"
Ormuz	1886	6,387	Nil	"
Austral	1881	5,524	"	"
Orient	1879	5,631	"	"
Royal Mail Steam Packet Company.				
Danube	1893	5,946	3,250	Oct. 1, 1905
Nile	1893	5,946	3,250	"
Thames	1890	5,645	Nil	"
Clyde	1890	5,645	"	"
Tagus	1899	5,545	"	"
Trent	1900	5,573	"	"
Magdalena	1889	5,362	"	"
Atrato	1888	5,366	"	"
Pacific.				
Ortona	1899	7,945	4,500	Oct. 1, 1905
Orizaba	1886	6,298	Nil	"
Oroya	1886	6,297	"	"
Oravia	1897	5,321	"	"
Canadian Pacific Railway Company.				
Emp. of India	1891	5,905	3,250	April 6, 1906
Emp. of China	1891	5,905	3,250	"
Emp. of Japan	1891	5,905	3,250	"
Tartar	1883	4,425	Nil	"
Athenian	1881	3,882	"	"

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Packing Apples for Great Britain.—I have recently received a communication from Mr. W. E. Boyes, of Leicester, chairman of the Conference of National Federation of Fruiterers, held at Cardiff, May 12 and 13, 1902, transmitting copy of a resolution adopted by the federation, which reads:

"This federation wishes to call your attention to the unsatisfactory way in which the American apples are packed, and asks if it is not possible for you to adopt the same system as Canada, and have all the apples graded and stamped with the government stamp. By so doing you will largely increase the demand for best quality and, consequently, the price of American fruit."

It is stated in the report of the conference that Canadian apples are now graded and stamped with the government stamp, and for all barrels sent out without the stamp the sender is liable to a fine of $1 for each barrel.—Richard Westacott, Acting Consul-General at London.

Danish Markets for American Hats.—Consul John E. Kehl, of Stettin, informs the Department, May 29, 1902, that he has recently received a letter from a Copenhagen firm, requesting addresses of American manufacturers of hats, and stating that Denmark would very likely prove an excellent market for these goods. The consul also refers to his recent report "German Market for American Hats," published in Advance Sheet No. 1279 (March 3, 1902), and says that so far only one American house has shown any disposition to avail itself of the opportunity offered to capture this trade.

Wheat and Flour in Manchuria.—Two modern flouring mills with American machinery have recently been constructed at Harbin, one with a capacity of 250 barrels and the other of 500 barrels a day. They are operated by Russian millers, and the product is said to be very satisfactory. The buildings are covered with American iron roofing.

The flour from these mills is going into the markets of Manchuria in competition with flour from the United States.

Soil.—The soil of the larger part of Manchuria and Mongolia is of a sedimentary formation, many feet in depth, and very productive. While I have not been able to secure an analysis, I am satisfied that it contains the same elements for wheat production as the Columbia River basin, in the United States. I inclose a sample of the best wheat that I have yet found in Manchuria.*

Climate.—The winters are very cold, freezing the ground to a depth of several feet; but this thaws out in April, and by the middle of the month the fields are cultivated as easily as beds of ashes. Spring rains are sufficient to start the grain well, and during July the rains are very heavy, always providing sufficient moisture for the maturing of crops. Famines are therefore not features of this section. During the maturing and harvesting period, the season is dry. The winters are also very dry.

The country is cultivated in large tracts, mules and ponies being used. I have seen as many as six mules pulling a single plow. The plows are cheap and crude, and plowing is always shallow. Harvesting and threshing are done by the hand methods common in other parts of China. The roads in winter are very good, and the Chinese can haul grain distances at very low cost.

Cost of Wheat.—The mills are able to secure wheat at 35 kopecks (18 cents) per pood (36.112 pounds)—about half a cent gold per pound—and the supply at this price is unlimited. Three grades of flour are produced here, and it is sold at the following rates: First grade, 2.60 rubles ($1.34) per 50-pound sack; second, 2.35 rubles ($1.21); third, 1.75 rubles (90 cents). The bran is sold for 15 kopecks (7.7 cents) for 36 pounds.

Transportation.—Harbin is situated on the River Sungari, at the point where the Chinese Eastern Railway joins the Central Manchurian and where the latter crosses the river. The Central Manchurian runs to Vladivostock, about 350 miles away. The Chinese Eastern Railway reaches the sea at Niuchwang, at a distance of about 450 miles, and Dalny and Port Arthur at 600 miles. The River Sungari is navigable for half of the year for steamboats that ply from Harbin to Harbarovsk, where they meet ocean-going vessels.

Market for Agricultural Machinery.—If flouring mills continue to increase in number, there is a probability of a market for American plows and harvesting and threshing machinery throughout this section. As mules are used in cultivation and hauling, and as the land is cultivated in large tracts and the country is not thickly populated, no great change would be required to bring about the use of machinery. The greatest difficulty will be to provide tools of a sufficiently cheap type. A fairly good plow that could be sold at a very low cost might find a market in Harbin now; but its primary characteristic must be cheapness.—Henry B. Miller, Consul at Niuchwang.

Maltese Trade Openings.—Flour.—The present opportunity should be taken advantage of by those interested in exporting flour to Malta. Of late, wheat imports from the United States have fallen off, but this decrease has been met by a corresponding gain in the manufactured product. In the opinion of local merchants, the new duties imposed in England will stimulate trade with the United States. English flour has for the past three or four years been our greatest competitor here, and it will be readily seen that our product, when sent direct, will enjoy a slight advantage. Within the past few weeks, several merchants who have always dealt largely in English flour, and have seldom bought American, have sent orders to the United States. One large baking establishment, which I could never seem to interest in our goods, has received a shipment by the latest direct vessel from New York. Others are soon likely to follow. Previous to 1899, when we had no direct communication, local statistics fail to show the arrival of any American flour, the small imports being credited to the English or Italian port of transshipment. During that year, and since, the demand has grown. The following table of imports of flour at Malta shows the progress we have made. Statistics for this year will show a further increase:

Place of Export.	1897. Bags.	1898. Bags.	1899. Bags.	1900. Bags.	1901. Bags.
New York	.....	.....	2,256	39,586	37,047
Liverpool	17,553	54,111	168,418	185,600	187,346
Marseilles	16,268	10,037	15,181	26,077	8,251
Trieste	268	1,742	1,494	637	1,373
London	2,165	3,240	3,855	2,183	10,575
Syracuse	27	760	1,765	1,596	5,544
Lisbon	.....	.....	.....	.....	12,862
Manchester	10,899	26,206	.....	.....	.....
Total	47,180	96,091	192,969	255,679	262,998

Corn.—A vessel arriving here yesterday from New York brought a small quantity of corn. This is the first American corn landed at Malta for many years, and the fact that it was promptly sold upon arrival leads me to believe that it will soon be brought regularly. The people of the island are not very well acquainted with our cereals, but there is no reason why they should not become so.

Carriages and Harness.—An experimental order just received here has proved disappointing. Several carriages and sets of harness are now en route for Malta from the United States, but if upon arrival they do not prove more satisfactory than those received this week, I fear we shall not do much business in these lines. The catalogues from which the order was made up held out many inducements, and the buyer was led to expect better finish and material than were realized. Had these goods been satisfactory, a duplicate order would have been promptly sent. It would pay some of our exporters to exercise more care in the preparation of goods that are ordered experimentally.

Soda Fountains.—It would appear that the American soda fountain is about to invade Malta. One of the most prominent druggists here is soon to remodel his store, and has asked me to supply him with illustrated catalogues, not only of fountains, but also of the necessary machinery for charging the water. I feel confident that if this fountain is installed, others will follow. Any printed matter upon this subject that may be sent me will be handed to the person referred to. In quoting prices, give lowest export terms f. o. b. New York. I would suggest that matter appertaining to sirups be also sent.

Electric Goods.—Of late I have been receiving letters from American houses dealing in various lines of electric goods. This is not a very large field for these articles. The supply of electric energy is under the control of a government bureau, which has a plant providing light for the streets, public buildings and many private houses. The alternating current voltage in consumers' premises is about 100 volts; the periodicity is about 100 cycles per second. There is no direct current used in the islands. Apart from illumination, there is very little demand for electric goods.

Commercial Travelers.—Two representatives of American houses have been here lately, for the purpose of making a study of trade conditions, and I am informed that their visits have been highly satisfactory. One of them told me that he could never understand why his house did not obtain more trade from Malta, but his visit had so equipped him with knowledge of conditions that he would have no difficulty in increasing the trade. I would like to see here the representative of one of our large hardware houses, as, if he brought samples, I believe he could lay the foundation of a good business. I am in the habit of taking great pains with this class of visitors, in order that they may meet the most desirable merchants.

Commercial Museum.—Malta, of course, is but a small place; all of the business is done in the capital city of Valletta. It must be remembered, however, that this island is a good distributing point. Steamers leave here daily for all parts of the Mediterranean and the trade is more important than would otherwise be the case. If some of our merchants could unite in opening a small commercial museum here I believe it would be productive of good results. Rents and labor are very low and, outside of the cost of sending samples, the individual expense would not be great. Some years ago this plan was put into operation by the local representative of Austria-Hungary. An exhibit of various lines of goods was made, and, although it was open but a few months, it created a great deal of interest, and as a result, certain lines of Austrian goods have become standard here and are to be found in many of the stores. Especially is this true of bentwood furniture. The people of Malta are rather favorably inclined toward our goods, but many hesitate to experiment with first purchases. If they could visit a place here and inspect samples of the goods desired, it would no longer be a matter of experiment but of certainty. I offer the suggestion for what it is worth, and will be pleased to give any further information required.—John H. Grout, Consul at Valletta.

Opening for Railroad Material in Rio Grande Do Sul.—Under date of May 23, 1902, Minister C. P. Bryan, of Petropolis, transmits a report from Mr. Dawson, secretary of legation, regarding the equipment and material needed for the New Hamburg and Taquara Railroad. This road is 29.8 miles long, and traverses a fertile and thickly populated region hitherto without railroad facilities. The roadbed and right of way, including culverts but not the longer bridges, are practically ready for the rails. The material needed is as follows: For two bridges 21.8 yards long, overhead truss, 5.4 yards between supports; one bridge, undergirder 17.4 yards, 3.8 yards between supports; one bridge, undergirder 8.7 yards, 3.8 between supports; six undergirder bridges, one 6.5 yards, three 5.4 yards, and two 4.3 yards long; 1960 tons of rails, 44 pounds per running meter (1.09 yards), and fishplates and screws for same; spikes for 29.8 miles; 20 complete turn-outs or switches; two turn-tables; 102 pairs of wheels and appurtenances, axle boxes, springs, etc.; 10 complete trucks, American "bogie" system; 31 locomotives of 25 tons, for a maximum grade of 0.98 inch per meter (1.09 yards) and curve with radius of 109 yards, gage 1.09 yards, to pull 120 tons, with a velocity of 24.8 miles maximum (native coal); four complete apparatus for telegraphic transmission, Morse system; six telephone instruments; telegraph wire for 29.8 miles. Bids for the foregoing material are being received and considered by Dr. Augusto Carlos Legendre, 22 A Rua Rosario, Porto Alegre. No time has been fixed for closing the bids, but the company is under contract to have cars running the fall of 1902. It is desired that the bids be for material laid down in Porto Alegre, not including duties. Freighting to Rio Grande must be in vessels not drawing more than 13 feet. From Rio Grande to Porto Alegre freight goes in barges drawing from 8 to 8½ feet, and contracts can be made at $1.82 per ton. Bids have been received from German and Belgian firms. Mr. Dawson adds:

There is more railroad building now going on and in contemplation in Rio Grande than in any other State of Brazil, and all the mileage in existence is under Belgian or English management and control. The native coal mentioned as the fuel to be used by the locomotives is a sort of lignite, and is of low calorific value.

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No. 1385. July 7.—Mechanical Standardization in Great Britain—*Opening for Railroad Material in Rio Grande do Sul—*American Gas Coal in Italy—German Duty on Mineral Oil for Motors—Electric Roads in Switzerland—New Brazil-Mediterranean Steamship Line.

No. 1386. July 8.—Mining in France—Margarin Products in Austria—Trade of Port Arthur—Korean Ginseng Crop for 1901.

No. 1387. July 9.—Venezuelan Railway Project—Mines and Transportation Routes in British Columbia—Antwerp Geographical Exhibition—New Swedish Burner—Improvement of the Peiho River, China—Railway Project in Greece: Correction.

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No. 1389. July 11.—*American Coal and the French Market—*American Lumber in Rotterdam—Sugar Production in Spain—Drought in Australia—Guatemalan Northern Railway—Use of Electricity in Agriculture.

No. 1390. July 12.—New German Method for Measuring Fabrics—Consumption of Petroleum in Turkey—American Trade-Marks and Patents in Cuba.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

* Subject to a reduction of 25 per cent for each ship in receipt of pay ment for carrying mails.

* Filed in the Bureau of Foreign Commerce, where it may be examined by parties interested.

SELECTED FORMULÆ.

Dressing for Kid.—

Oil of turpentine	8 ounces
Suet	2 pounds
Soft soap	8 ounces
Water	16 ounces
Lamp black	4 ounces

—Drug. Circ.

Stains for Wood.—Purple: Boil 2 ounces of logwood chips in a quart of water until the color is well extracted and add solution of indigo to give the required shade. Yellow: Make a solution of anilin yellow in alcohol, and apply with a soft brush. By first applying a weak mahogany stain and then following it with yellow, a fine orange is secured. Mahogany: First rub the surface of the wood with a solution of nitrous acid, and then apply, with a soft brush, the following:

Dragon's blood	1 ounce
Sodium carbonate	¾ ounce
Alcohol	20 ounces

—Drug. Circ.

Hektograph Inks.—

Black.

Methyl violet	10 parts
Nigrosin	20 parts
Glycerin	30 parts
Gum arabic	5 parts
Alcohol	60 parts

Blue.

Resorcin blue M	10 parts
Dilute acetic acid	1 part
Water	85 parts
Glycerin	4 parts
Alcohol	10 parts

Dissolve by the aid of heat.

Red.

Fuchsin	10 parts
Alcohol	10 parts
Glycerin	10 parts
Water	50 parts

Green.

Anilin green, water soluble	15 parts
Glycerin	10 parts
Water	50 parts
Alcohol	10 parts

—Drug. Circ.

To Cement Tortoise Shell.—Fit the broken pieces carefully and wrap in a piece of paper to hold them firmly in place. Heat two pieces of iron and place the article with the paper around it, between them. The iron must not be so hot as to burn. Squeeze the article between the iron pieces for a few minutes, and allow it to cool. The shell melts and forms a cement which firmly joins the broken parts.—Drug. Circ.

Starch Polishes.—

I.

Water	140 parts
Fine wheat starch	160 parts
Farina	40 parts
Heavy magnesia	20 parts
White curd soap	12 parts
Spermaceti	10 parts
Japan wax	10 parts
Carbonate of sodium	4 parts
Ultramarine	1 part

Stir the blue in the water; then melt the soap, spermaceti, and wax, and add the carbonate, stirring well. Next mix the starches and magnesia, free from lumps, with the water; add others, and boil until thoroughly mixed. Then run the mixture through a strainer.

II.

Bleached carnauba wax	30 parts
Powdered French chalk	20 parts
White soap	12 parts

—Drug. Circ.

Varnish for Polished Copper.—

Sandarac	110 parts
Rosin	30 parts
Glycerin	5 parts

Alcohol, a sufficient quantity.

Dissolve the two resins in sufficient alcohol and add the glycerin.—Drug. Circ.

To Drive Ants Away.—

Water	1 quart
Cape aloes	4 ounces

Boil together and add:

Camphor in small pieces	1½ ounces

—Drug. Circ.

To "Oxidize" Silver.—Silver may be colored a brownish-black by the following solution:

Ammonium chloride	2 parts
Copper sulphate	2 parts
Potassium nitrate	1 part
Acetic acid	5 parts

If only a part of an article is to be colored, apply the solution with a camel's hair brush, to the parts. If the entire article is to be colored, immerse it in the solution. In both instances the article and the solution should be previously warmed.—Drug Circ.

To Remove Rust from Nickel.—Smear the rusted parts well with grease (ordinary animal fat will do) and allow the article to stand several days. If the rust is not thick the grease and rust may be rubbed off with a cloth dipped in ammonia. If the rust is very deep, apply a diluted solution of hydrochloric acid, taking care that the acid does not touch the metal, and the rust may be easily rubbed off. Then wash the article and polish in the usual way.—Drug. Circ.

Remedy for Warts.—

Salicylic acid	2 parts
Alcohol	2 parts
Ether	5 parts
Collodion	10 parts

Paint the warts every morning with the solution.—Drug. Circ.

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